ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF SACROILIAC JOINT IN PATIENTS WITH UNSTABLE SACROILIAC JOINT DISRUPTIONS

Dissertation submitted for

M.S DEGREE EXAMINATION

BRANCH II-ORTHOPAEDIC SURGERY

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI-600032

APRIL -2014

CERTIFICATE

This is to certify that this dissertation in **"ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF SACROILIAC JOINT IN PATIENTS WITH UNSTABLE SACROILIAC JOINT DISRUPTIONS"** is a bonafide work done by **Dr. KETHARAN.S.K** under my guidance during the period 2011–2014. This has been submitted in partial fulfilment of the award of M.S. Degree in Orthopedic Surgery (Branch–II) by The Tamilnadu Dr.M.G.R. Medical University, Chennai.

PROF.N.DEEN MUHAMMAD ISMAIL
PROFESSOR & CHIEF,
INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY
MADRAS MEDICAL COLLEGE & RAJIV GANDHI GOVT GEN. HOSPITAL
CHENNAI – 3.

PROF.V.KANAGASABAI, M.D.,
DEAN
MADRAS MEDICAL COLLEGE& RAJIV GANDHI GOVT GEN. HOSPITAL CHENNAI-3.

CERTIFICATE

This is to certify that this dissertation in **"ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF SACROILIAC JOINT IN PATIENTS WITH UNSTABLE SACROILIAC JOINT DISRUPTIONS"** is a bonafide work done by **Dr. KETHARAN.S.K** under my guidance during the period 2011–2014. This has been submitted in partial fulfilment of the award of M.S. Degree in Orthopedic Surgery (Branch–II) by The Tamilnadu Dr.M.G.R. Medical University, Chennai.

PROF.M.R.RAJASEKAR
DIRECTOR,
INSTITUTE OF ORTHOPAEDICS & TRAUMATOLOGY
MADRAS MEDICAL COLLEGE &
RAJIV GANDHI GOVT GEN. HOSPITAL
CHENNAI- 600003.

DECLARATION

I, **Dr.KETHARAN.S.K,** solemnly declare that the dissertation titled **"ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF INTERNAL FIXATION OF SACROILIAC JOINT IN PATIENTS WITH UNSTABLE SACROILIAC DISRUPTIONS"** was done by me at the Rajiv Gandhi Government General Hospital, Chennai-3, during 2011-2014 under the guidance of my unit chief **Prof.N.Deen Muhammad Ismail, M.S(Ortho), D.Ortho.** The dissertation is submitted in partial fulfilment of requirement for the award of M.S. Degree (Branch –II) in Orthopaedic Surgery to **The Tamil Nadu Dr.M.G.R.Medical University.**

Place:

Date: **Dr. KETHARAN.S.K**

ACKNOWLEDGEMENT

I express my thanks and gratitude to our respected **Dean Prof.V.KANAGASABAIM.D.,** Madras Medical College, Chennai–3 for having given permission for conducting this study and utilize the clinical materials of this hospital.

My sincere thanks and gratitude to my **Director and HOD, Prof.M.R.RAJASEKAR M.S Ortho., D.Ortho**., for his constant inspiration and guidance throughout the study.

I have great pleasure in thanking my guide and my respected teacher **Prof.N.DEEN MOHAMED ISMAIL M.S.Ortho., D.Ortho.** Professor of Orthopaedics, Institute of Orthopaedics and Traumatology, for his valuable advice and guidance.

My sincere thanks and gratitude to **Prof. V. SINGARAVADIVELU M.S.Ortho., D.Ortho,** Professor, Institute of Orthopaedics and Traumatology, for his constant advice and guidance provided throughout this study.

My sincere thanks and gratitude to **Prof. A. PANDIASELVAM M.S.Ortho., D.Ortho,**Additional Professor, Institute of Orthopaedics and Traumatology, for his valuable advice and guidance.

My sincere thanks and gratitude to **Prof. NALLI R. UVARAJ M.S.Ortho., D.Ortho,** for his constant advice and guidance provided throughout this study.

My sincere thanks to **Prof. SUDHEER M.S.Ortho., D.Ortho.,** Associate Professor, Institute of Orthopaedics and Traumatology, for his valuable advice and guidance.

I am very much grateful to **Prof. R. SUBBIAH M.S.Ortho., D.Ortho,** for his unrestricted help and advice throughout the study period.

My sincere thanks and gratitude to **Prof. ANBAZHAGAN M.S.Ortho., D.Ortho,** for his constant advice, guidance and unrelenting support provided throughout this study.

My sincere thanks to **Prof. R.H. GOVARDHAN. M.S.Ortho., D.Ortho.,** former director, Professor, Institute of Orthopaedics and Traumatology, for his valuable advice and guidance.

My sincere thanks and gratitude to my assistant professor **Dr.S.Senthil Sailesh , M.S. Ortho.,** for his valuable guidance and support in this study.

My sincere thanks and gratitude to my assistant professor **Dr.K.Velmurugan, M.S. Ortho.,** for his constant advice and guidance provided throughout this study.

My sincere thanks to my assistant professor **Dr.P.Kannan, M.S.Ortho.,** for his support and helping me in my clinical work.

. I sincerely thank my Assistant Professors **Dr.A.Shanmugasundaram, S.Karunakaran, Dr.K.P.Manimaran, Dr.R.Prabhakaran, Dr.P.Kingsly, Dr.Muthazhagan, Dr.Kaliraj, Dr.Nalli R.Gopinath, Dr.Hemantha Kumar, Dr.Muthukumar ,Dr. J.Pazhani, Dr. Md.Sameer and** of this department for their valuable suggestions and help all during this study.

I thank all anaesthesiologists and staff members of the theatre for their endurance during this study.

I am very grateful to all my post graduate colleagues for helping in this study.

Last but not least, my sincere thanks to all our patients, without whom this study would not have been possible.

CONTENTS

ABSTRACT

INTRODUCTION

Sacroiliac joint disruptions occurs commonly following high velocity injuries like road traffic accidents. These injuries are unstable and are associated with high rate of mortality and morbidity following conservative management. Mortality is commonly due to hemorrhage and morbidity is due to pain in sacroiliac joint due to articular incongruiety (arthritis). Early anatomical reduction and internal fixation of sacroiliac joint disruptions results in reduced mortality and morbidity.

AIM OF THE STUDY

The aim of the study is prospective analyse of the functional outcome in patients with sacroiliac joint disruptions managed surgically with internal fixation. The study period is from October 2011 to October 2013.

MATERIALS AND METHOD

This study was conducted in 21 patients got admitted in Rajiv Gandhi Government General, Chennai. All hemodynamically stable patient with unstable type B and type C closed sacroiliac joint disruptions were included in study. Hemodynamically unstable and patients with open injuries are excluded from study.

All patients were subjected to preoperative complete blood investigation, pelvic x-ray (inlet, outlet and AP view), and CT scan. After 24-36 hours observation patients were taken for surgery, either 6.5 cannulated cancellous screw or recon plate used. In patients, were closed reduction achieved percutaneous cannulated cancellous screw fixation done and in patients were closed reduction not possible open reduction and internal fixation done with either cancellous screw or reconstruction plate. Post operatively during follow up patients were assessed clinically (sacroiliac joint stress test), radiologically (pelvic x-ray for assessing joint and implant status) and functionally using pelvic outcome scale (Cole et al).

RESULTS

In, our study 21 patients with unstable sacroiliac joint disruptions were treated with definitive internal fixation and followed for an average period of 8.7 months (range 4-16 months). The functional outcome of patients based on pelvic outcome scale by Cole et al was good for 18 patients and fair for two patients.

CONCLUSION

Anatomic reduction and internal fixation of unstable sacroiliac joint injuries gives excellent stability, allows early mobility and good functional outcome. Percutaneous fixation was as rigid as open reduction and internal fixation.

INTRODUCTION

INTRODUCTION

Sacroiliac joint disruptions commonly occurs in young adult patients due to high energy or velocity injuries like road traffic accidents(pedestrian Vs automobile), falls and crush injuries in industrial accidents[21]. Associated neurovascular (iliac artery and sacral nerve roots) and visceral (bladder, urethra and intestine) injuries[16] makes its management to orthopaedic surgeon more challenging and complex. There is significant amount of morbidity and mortality associated with sacroiliac disruption. The mortality may be early in patients due to vascular injury/haemorrhage or associated injuries and late due multi organ dysfunction or sepsis.

Most of the sacroiliac disruptions are unstable injuries. Most of the injuries were managed with non-operative techniques like pelvic belt, slings, skeletal and skin traction initially, mainly aiming to reduce or prevent the cephalad migration of hemipelvis. Conservative management resulted in articular incongruity subsequently leading to long standing pain and discomfort due arthritis[15,17].

Initially, the literature gave more importance to the life threatening complications associated with sacroiliac disruption than understanding the natural course of the disease. Of late this led to poor prognosis in the conservatively treated patients[15,17]. Lack of knowledge regarding the biomechanics of bony and ligament complex and the pattern of injury, the

techniques of internal fixation of sacroiliac joint led to poor functional outcome in patients who survive this injury. Management started evolving gradually, then came the concept of early internal fixation[4] in patients with sacroiliac joint disruptions.

In my study, a detailed briefing regarding the anatomy and biomechanics of pelvic ligament complex, the mechanism and classification of different types of unstable sacroiliac joint disruptions will be presented which is followed by detailed clinical examination and radiological survey of the patients with sacroiliac disruptions and various surgical modalities of management for them. Finally we have analysed the functional outcome in these patients with sacroiliac disruption managed surgically with internal fixation.

AIM OF THE STUDY

AIM OF THE STUDY

The aim of the study is prospective analyse of the functional outcome in patients with sacroiliac joint disruptions managed surgically with internal fixation. The study period is from October 2011 to October 2013.

.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

Mechanisms of sacroiliac injuries and other pelvic fractures was first described by Malgaigne in 1859

Sacroiliac pain a common consequences that follows pelvic fracture was described by Westerbon in 1928 and Wilenius in 1943

Retroperitoneal bleeding as a major cause of death following pelvic injuries was suggested by Holdsworth in 1948. He studied on 50 pelvic fractures and demonstrated the mechanism of pelvic fracture. On careful observation of his studies it shows close association between anatomic reduction and prognosis in form of functional outcome

The first classification of pelvic injuries on the basis whether the injury affects the weight bearing area of pelvis or not was given by Peltier in 1965. He studied on 186 patients with pelvic disruptions to give this classification.

Patients with unstable Malgaigne fractures were studied by Raf in 1966. He conducted his study in 101 patients and concluded that the functional outcome was better in patients with posterior iliac fracture and poor in patients with sacroiliac joint disruptions or sacral fractures.

A large series of 407 cases were reported by Huittinen and Slatis in 1972, dividing them into two groups stable and unstable on the basis of whether the posterior weight bearing arch of the pelvis has been disrupted or not. Complications both early and late were attributed mostly to the unstable variety.

Slatis and Karaharju conducted a comparative study with a series of 22 cases with unstable pelvic injuries. All the patients in their study were treated with trapezoidal external frame and finally they came to the conclusion that the patients with unstable injuries treated with external fixation had decreased incidence of late musculoskeletal complications.

In 1973 Reynolds et al conducted study in 273 cases and reported 18.6% mortality in which severe hemorrhage was the cause of mortality in more than 60%.

The Locked symphysis, a rare type of pelvic injury was first reported in 1970 by Shanmugasundaram.

High incidence of permanent neurological sequalae following posterior arch injuries was reported by Monahan and Taylor in 1975 following his review of 29 patients

Pelvic fracture classification on the basis of direction of injury force vector was made by Penal et al in 1980. They classified into anteroposterior compression, lateral compression and vertical shear.

Epidemiological study on sacroiliac joint injuries was conducted by Melton et al in 1981 among Rochester residents and he made out an incidence of 37 per 100,000 pelvic injuries in them

A study in patients with open pelvic injury was conducted by Rothenberger et al in 1978 and Perry in 1980. They reported that in death following patients with open pelvic injury had three times the blood loss of the patients who expired following closed pelvic injury.

A versatile research on patients with pelvic injury was done by Marvin Tile in 1983. The classification made by him, which is followed across the world, now was based on the stability of the injured pelvis and the direction of the injuring force vector. The classification, biomechanics and management of pelvic fractures with modern surgical techniques was explained in detail in his book entitled “fractures of pelvis and acetabulum”.

Patients with open pelvic injuries who expired due to sepsis has cause of death was studied in detail by Raffa and Christensen in 1974. In their study conducted on 16 patients, 8 expired following open pelvic injury, of which 7 were due sepsis of pelvis. They also reported that mortality

following immediate colostomy in open pelvic injury patient was 25% as compared to 58% mortality in patients in whom colostomy was either delayed or not all done.

A study on 50 patients with unstable pelvic injury treated with external stabilisation was conducted by Edwards et al in 1985. Their study concluded that pelvic injuries with vertical instability cannot be stabilised with anterior external frame.

The end result following in patients with sacroiliac joint disruption depends on the anatomical reduction of sacroiliac joint and stability of internal fixation was further reiterated by the study of Kellam et al in 1987. Their study was conducted on 53 patients with unstable pelvic disruptions managed with anterior external fixator.

APPLIED ANATOMY

APPLIED ANATOMY

Anatomy of sacroiliac joint is necessary for thorough understanding of the biomechanics of injury, classification and in management of patients with these injuries. To know the importance of sacroiliac joint in pelvic stability one should have basic idea of the pelvis as a whole. With recent increase in trends towards minimally invasive techniques in management of displaced sacroiliac joint injuries, the detailed anatomy of pelvis assumes greater importance. The following section reviews the salient features of pelvic anatomy pertinent with management of traumatic sacroiliac disruptions.

OSSEOUS ANATOMY

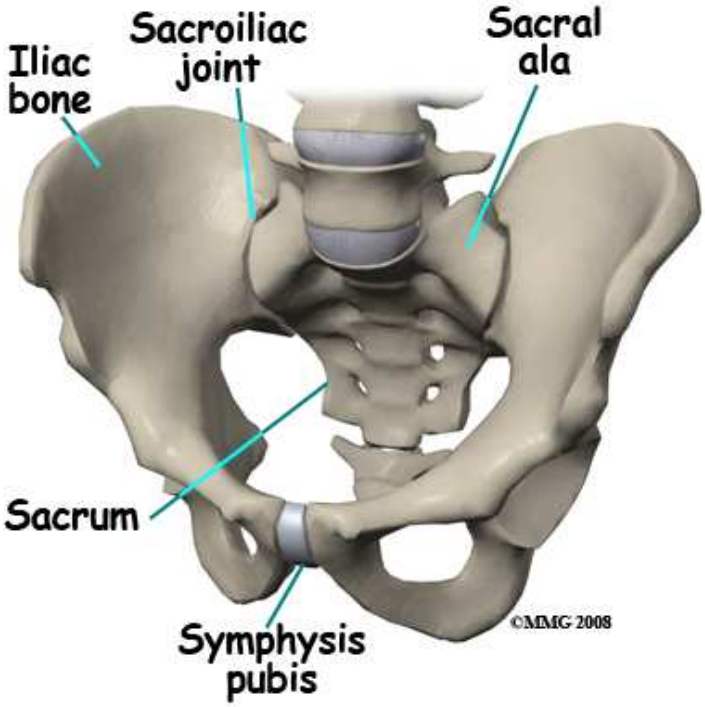
Pelvis means basin in latin, is a ring structure with three bones namely the sacrum and the two innominates constituting it. Each innominate bone is formed by the fusion of three separate centres of ossification, the ilium, the ischium, and the pubis. These bony complex does not have any inherent stability[25,26], the soft tissues mainly the ligamentous structure constitutes the stability to pelvis to withstand high forces.

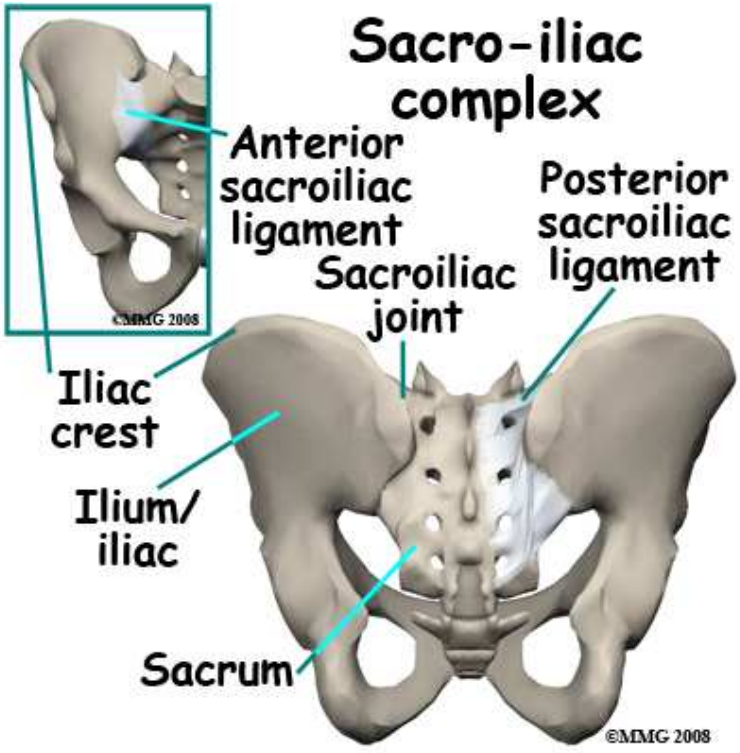
Sacrum connecting the innominate bone on each side at the sacroiliac joint and the pubic symphysis completes pelvic ring. The sacroiliac joint along with the ligaments forms the major stabilising structure posteriorly

because the weight bearing axis are transmitted across the sacroiliac joint and into the femoral neck. The symphysis pubis has nothing to do with weight bearing instead it acts like a strut preventing the collapse of pelvis. Sacroiliac joint is an irregular joint and technically it is an apophyseal joint.

OSSEOUS ANATOMY OF SACRUM WITH RESPECT TO SACROILIAC JOINT

Ziran et al and Ebraheim et al had only recently described the important osseous landmarks of posterior pelvis and sacrum and their specific orientation with relation to radiographic imaging. The area of paramount importance when placing iliosacral screws is the S1 ala where L5 nerve root lies. Dysmorphisms[27] of superior ala either concave or convex should be kept in mind. There can also be either a sacralization of theL5 vertebral body or lumbarisation of S1 body. There is a bony confluence of the alar and vertebral structures in sacralisation and there is some separation of the alar and vertebral structures of S1 and S2 in lumbarisation of S1[27]. The visualization of superior ala and iliosacral joint in normal sacrum are important during the placement of percutaneous sacroiliac joint screws since there can be a risk of injuring the L5 nerve root. In order to minimize the chance of an in-out-in screw, the entry point for sacroiliac joint screw should be inferior and posterior to the superior ala on the lateral ilium[26,27].


Iliac bone
Sacroiliac joint
Sacral ala
Sacrum
Symphysis pubis
©MMG 2008


Sacro-iliac complex
Anterior sacroiliac ligament
Posterior sacroiliac ligament
Sacroiliac joint
Iliac crest
Ilium/ iliac
Sacrum
©MMG 2008
©MMG 2008

The alar slope or iliac cortical density is the opacity seen in fluoroscopy due to confluence of sacral ala with iliac cortex, as well as the subchondral bone of the iliosacral joint. For directing percutaneous screws into the S1 body, the orientations of the anterior and superior aspects of the sacrum are important as they form the main landmarks.

Osseus anatomy of ilium with respect to sacroiliac joint

Sciatic buttress is a strong buttress of bone emanates from sacroiliac joint and runs towards acetabulum, which is mainly responsible for weight transfer[25]. A nutrient artery present lateral and anterior to the joint in the inner table is one of the reason bleeding during surgery in this area. There is a coalescence of lumbosacral plexus and gluteal vessels located near the joint, constituting important source of bleeding both during injury as well as during internal fixation. Posterior superior iliac spine is located posteriorly adjacent to the joint in outer ilium. The neurovascular structures along with piriformis muscle exits pelvis through the sciatic notch.

Ligamentous anatomy and their stability

Sacroiliac joint

Hyaline cartilage covering the articular surface of sacrum and fibrocartilage covering the adjacent surface of the ilium acts as dual wedge in antero-posterior and axial directions. In transmitting the weight to lower

limbs it is the corner stone. Sacroiliac joint is formed by the direct contact of sacrum and ilium embryologically. Their occurs little or no movement in the sacroiliac joint due to strong anterior and posterior ligament

The ligaments of sacroiliac joint is divided into deep and superficial ligaments[25,26].

Deep ligament

Interosseous sacroiliac ligament

It is the strongest ligament of the body. The tuberosities of sacrum and ilium are united by interosseous ligament.

Superficial ligaments

It is further divided into anterior and posterior sacroiliac ligaments.

Posterior sacroiliac ligaments

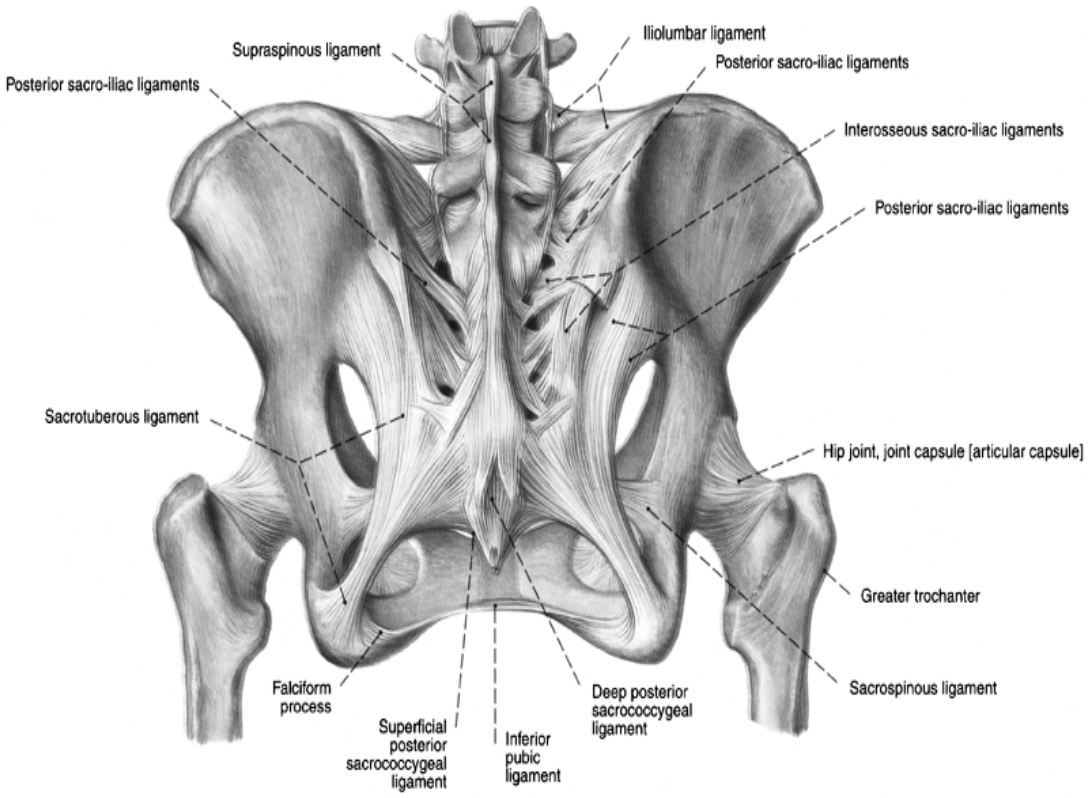
It has two different types of bands

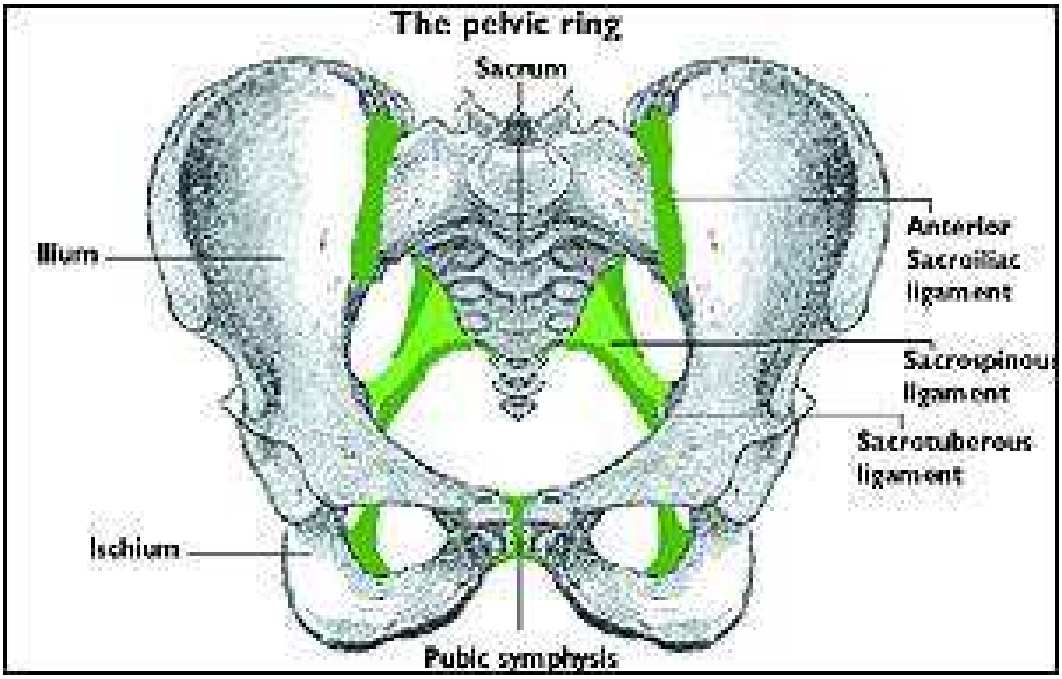
1.Oblique fibres constituting the short posterior sacroiliac ligament runs from the tubercle or ridge of sacrum to the posterior superior and posterior inferior iliac spine, which is also known as Bichat`s sacrospinous ligament[26].

2. Longitudinal fibres constituting the long posterior sacroiliac ligament runs from posterior superior iliac spine to the lateral portion of the sacrum, which is also known as Zagal`s ligament[26].

Anterior sacroiliac ligaments

These ligaments running from the anterior surface of sacrum to the adjacent anterior surface of the ilium are flat, strong bands composed of transverse and oblique fibres[15]. They are mostly capsular and are first to be disrupted during pelvic injury





Connecting ligaments

Sacrotuberous ligament

It extends as a broad band from the lateral portion of the entire dorsum of the sacrum[26] and the posterior surfaces of posterior superior and inferior iliac spines to the ischial tuberosity. It is an extremely strong ligament.

Sarospinous ligament

Arising from the lateral margin of sacrum and the coccyx and passing to the ischial spine, sacrospinous ligament is strong triangular ligament[15]. While running this ligament converts two notches into greater and lesser sciatic foramen. Greater sciatic foramen contains the piriformis muscle,

superior glutei nerves, sciatic nerve, ischial vessels, and internal pudendal vessels and nerve. The lesser sciatic foramen, contains the obturator internus muscle and internal pudenda vessels, which have crossed over the sacrospinous ligament (after exiting the pelvis via the greater sciatic foramen) to re-enter the pelvis via the lesser sciatic foramen

Iliolumbar ligament

Markedly thickened portion of the fascia covering quadrates lumborum is the iliolumbar ligament attaching the tip of the fifth lumbar transverse process to the iliac crest bilaterally.

Lateral lumbosacral ligament

The lateral lumbosacral ligament spreads downward from the L5 transverse process to the ala of sacrum.

POSTERIOR TENSION BAND

The above mentioned all posterior ligaments together forms the posterior tension band of pelvis, the transversely placed ligaments resist the transverse rotational force and the vertically placed ligaments are assigned to oppose the shearing longitudinal force[26].

ANTERIOR PELVIC STABILITY

Symphysis pubis

The hyaline cartilage covering the opposed bony surfaces are further reinforced by fibro cartilage and fibrous tissue bonding together the hyaline cartilage. The dense fibrous ligaments merges with the hyaline cartilage anteriorly and superiorly, inferiorly the symphysis is reinforced by the arcuate ligament.

THE PELVIC CAVITY

The presence of visceral organs[25] in pelvic cavity and the frequent association of visceral injuries with sacroiliac disruptions makes the interior of pelvic cavity very much important. The pelvic brim divides pelvic cavity into false pelvis above and true pelvis below with no muscle crossing pelvic brim. The pelvic brim continues anteriorly into the pectineal eminence and finally becomes confluent with the superior pubic ramus

False pelvis

The false pelvis consists of the sacral wing and iliac fossa covered by iliacus muscle.

True pelvis

The pubis and the ischium with a small triangular portion of ilium forms the lateral wall of the true pelvis. The obdurator vessels and nerve passing out thorough the obdurator foramen are vulnerable to injury. The pubis and ischium are separated by obdurator foramen. The important structure in this region is piriformis muscle bisecting the greater sciatic notch and in most human beings entire nerve leaves the pelvic cavity below this muscle.

Pelvic diaphragm

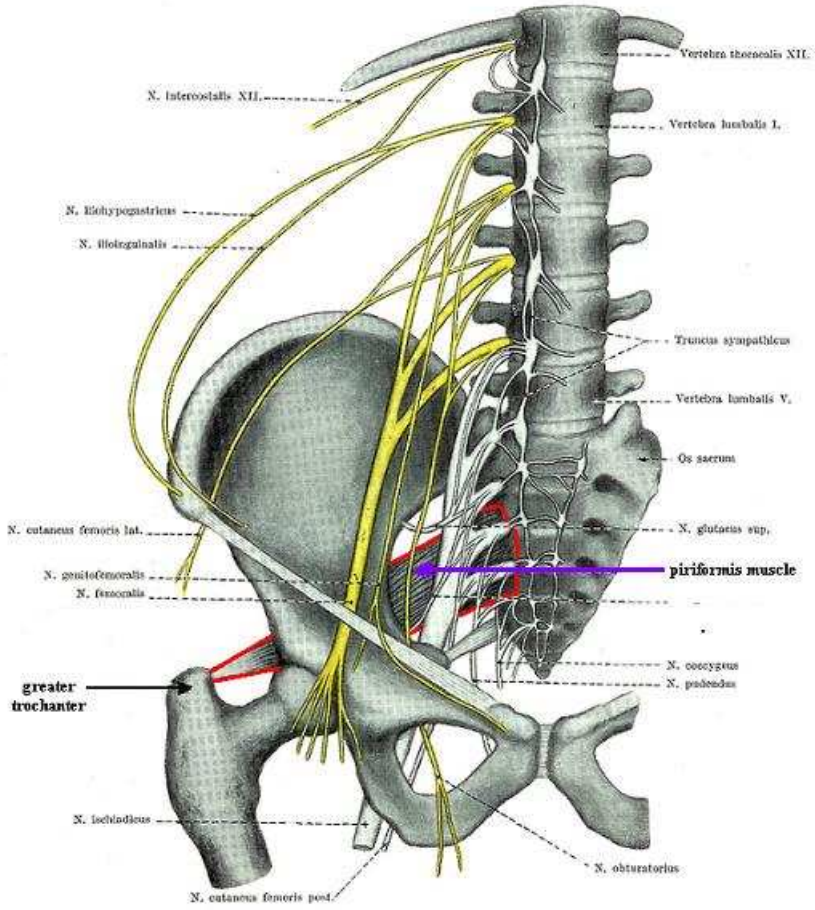
The pelvic diaphragm is formed by the spread of levator ani and coccygeus across the pelvis making the floor of the cavity to support the pelvic viscera[26]. The pelvic diaphragm separates the cavity from perineum and it is perforated by urethra, rectum and vagina.

STRUCTURES AT RISK DURING SACROILIAC DISRUPTION

Lumbosacral and coccygeal nerve plexus

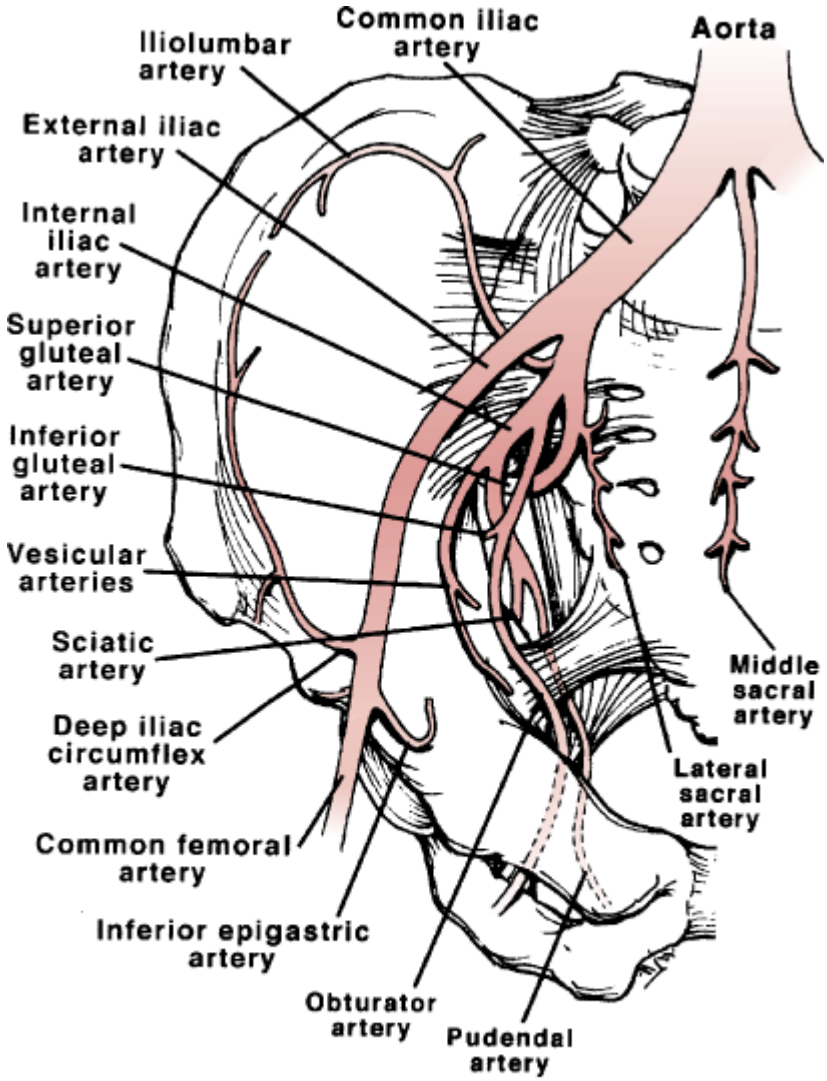
The plexus formed by the anterior rami of T12 – S4 in the pelvic cavity are of paramount important sacroiliac joint fixation surgeries. Sacroiliac disruptions associated with these plexus injury has been well documented including the femoral nerve injury.

The lumbosacral plexus[16] formed by L4L5 and first four sacral roots is situated in front of the anterior sacroiliac joint. They are critical structures at risk of injury during sacroiliac disruptions. A branch of L4 crosses the L5 transverse process and L5 grooves the ala of the sacrum[16,26]. These structures are at risk both during injury and also percutaneous fixation of sacroiliac joint. The lumbosacral plexus finally ends in two terminal branches, the pudental and sciatic nerve. It also has many collaterals.



VASCULAR ANATOMY

The most important cause of mortality following sacroiliac disruptions is massive haemorrhage[16] from major blood vessels. This mandates that one should have detailed knowledge of vascular structures in pelvic cavity. These structures can also be injured during surgical procedures. In managing sacroiliac injuries with haemorrhage embolisation[28] of bleeding vessels is also an life saving procedure. The arteries at risk are discussed below.



Source: Feliciano DV, Mattox KL, Moore EE: *Trauma*, 6th Edition: http://www.accesssurgery.com

Median sacral artery

Median sacral artery is a continuation of aorta and is frequently injured in sacroiliac disruptions.

The superior rectal artery

It is rarely injured and it is a continuation of superior mesenteric artery.

The internal iliac artery

Originating from the common iliac artery in false pelvis it is the vessel of critical importance. At the level of pelvic brim it splits into anterior and posterior divisions. Sacroiliac disruptions may disrupt the internal iliac[28] or sometimes it may even disrupt the common iliac artery if the degree of injury force is high.

Posterior division

The posterior division branches into superior gluteal, iliolumbar and lateral sacral arteries. All these branches are most prone to injury in sacroiliac joint disruptions.

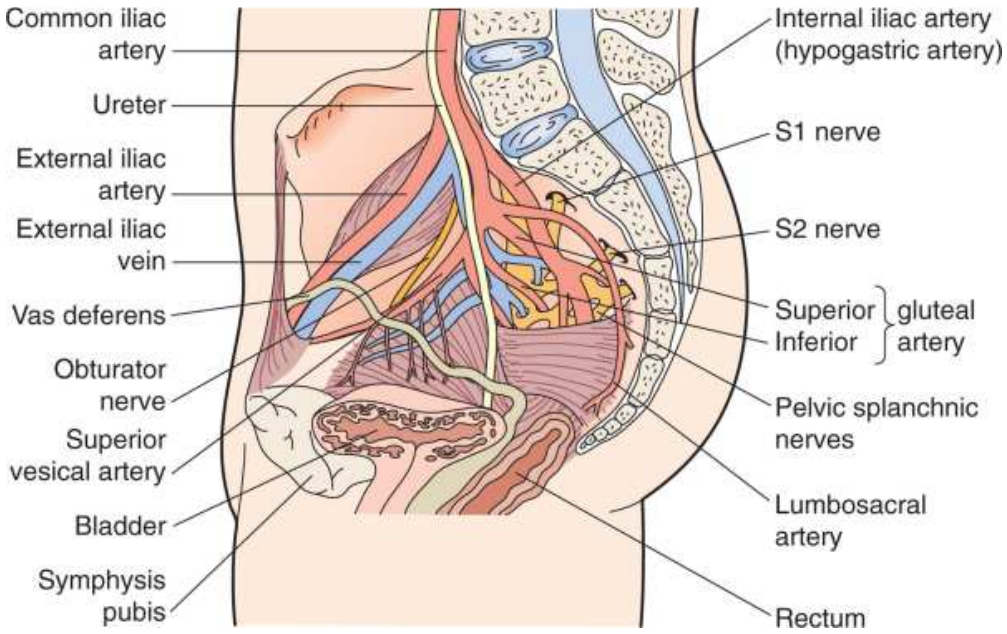
Anterior division

It gives rise to mainly visceral branches supplying the bladder, genitalia and a portion of rectum. The internal pudental and inferior gluteal artery are the lumbar and perineal branches arising from anterior division.

The pelvic veins

The venous plexus being thin walled may bleed torrentially[28,16] following pelvic injuries.

Visceral organs



The bladder, male urethra and the gastro intestinal tracts are the visceral organs at risk of injury.

Urinary bladder

Frequently, injured when it is full, mainly by the sharp spikes of fractured ends in case of fracture dislocation of sacroiliac joint and in association of other pelvic bone fractures.

Urethra

The bulbous and the membranous portion of the male urethra[16] are commonly injured.

Gastro intestinal tract

The pelvic colon, rectum and the anus of lower gastro intestinal tract[16] are injured more commonly in open pelvic injuries. Their association with sepsis is an important cause of mortality.

SACROILIAC JOINT BIOMECHANICS

BIOMECHANICS OF SACROILIAC STABILITY

In managing patients with sacroiliac injuries, understanding of pelvic stability is key. The pelvis as a osseous complex lacks inherent stability, the stability is mainly by the integrity of the ligaments[29]

Anteriorly, the intact pubic symhysis withstands external rotation. The main function of symphysis is to prevent the anterior collapse of pelvis during weight bearing.

Intact posterior sacroiliac complex is most important for pelvic stability[31]. It is complex network of ligaments making it to withstand the transference of weight bearing forces from the spine to lower extremities

External rotation and shearing forces are opposed by the anterior sacroiliac ligaments. The posterior displacement of pelvic ring is opposed by one of the strongest ligament in the body, the posterior sacroiliac ligament complex[32].

The horizontally running fibres of sacrospinous ligament withstands the external rotation of hemipelvis and the vertically running fibres of the sacrotuberus ligament withstands the vertical displacement of hemipelvis[29].

CONCEPT OF SACROILIAC STABILITY

The pelvic ring is considered as a single anatomical structure for practical purpose. The corner stone in managing patients with pelvic injury is analyzing the sacroiliac stability. The energy of the insult is directly proportional to the degree of pelvic instability. Stable, partially unstable and completely unstable are the three types of stability forming the basis for classifying the pelvic injuries.

STUDIES ON SACROILIAC BIOMECHANICS

Division of ligaments

Pennal in 1961 demonstrated that cutting the pubic symphseal ligaments alone allows pelvis to open only 2.5cm, further opening opposed by posterior ligament complex. Cutting the anterior sacroiliac ligaments makes the pelvis to open like a book. Translations occurs at the sacroiliac joint with division of posterior sacroiliac ligaments making the entire hemipelvis unstable.

The actual contribution of various ligaments to pelvic stability is much more complex, which was reported by the recent study from Tile`s laboratory.

Division of osseous complex

It is not possible to break the pelvis in just one spot because the whole pelvis behaves like an intact ring structure. In the clinical study conducted by Gertzbein and Chenoweth, patients with minimally displaced fracture at one spot were subjected to technetium bone scan and uptake was noted in sacroiliac region in all cases.

INJURING FORCE AND THEIR MECHANISM

Force patterns

The direction of force causing injury has high predictable value on the fracture patterns and this was first described by penal. Four types of force acts on pelvis and they are[31]

1. Anterior–posterior compression (APC) injuries
2. Lateral compression (LC) injuries
3. Vertical shear (VS) injuries
4. Combined mechanical (CM) injuries

Anteroposrerior compression(APC)

Pelvis opens like a book with this direction of force[31,32]. Force may be of two types either direct or indirect. Direct is again of two types, either a direct posterior crush on the posterior superior iliac spines or by the direct pressure to the anterior superior iliac spine. The indirect force is mainly thorough the external rotation of femur.

Lateral compression (LC)

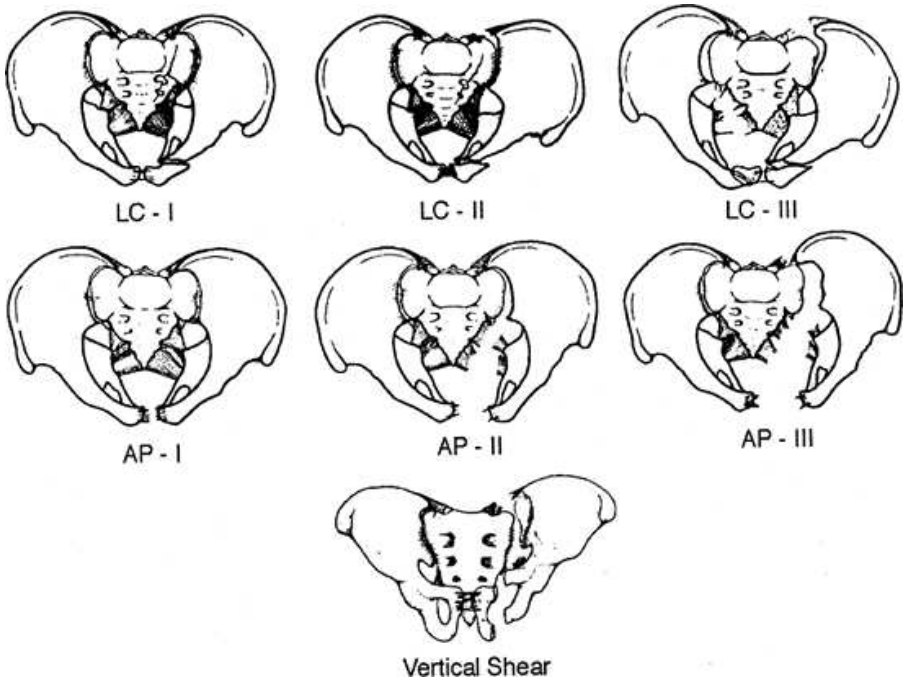
Generally the lateral force vector causes pelvis to collapse towards midline. Lateral force applied directly on the iliac crest or to the greater trochanter causes major thrust to the posterior sacroiliac complex.

When subjected to only pure compression without any shearing element, the outcome is stable anterior lesion with the posterior soft tissue remaining intact[29]. In combination of both compression and shearing element the outcome is unstable pelvic injury with both anterior and posterior lesions[31].

Posterior injuries can be an intact posterior complex with impacted fracture of anterior sacrum, crushed anterior sacrum with rupture of posterior sacroiliac ligament complex[32] and impacted sacroiliac joint with ruptured posterior ligamentous complex.

Vertical shear (VS)

The injuring force vector acts perpendicular to the main trabecular pattern of the posterior pelvic complex in either posterior or vertical plane[32]. The pelvis becomes highly unstable with major disruption of ligamentous complex and marked displacement. Traumatic hemipelvectomy is produced if the injuring vector force is severe.



LC: anterior injury = rami fractures

LC I: sacral fracture on side of impact

LC II: crescent fracture on side of impact

LC III: type I or II injury on side of impact with contralateral open book injury

AP compression (APC): anterior injury = symphysis diastasis/rami fractures

APC I: minor opening of symphysis and SI joint anteriorly

APC II: opening of anterior SI, intact posterior SI ligaments

APC III: complete disruption of SI joint

Force pattern and its effect on viscera and soft tissue

The strong vector force causing ligament disruption will also produce effects on the surrounding soft tissue namely the vessels, nerves and viscera. Lateral compression injuries damages the bladder or urethra and injury to sacral nerve roots are produced when compression occurs at the sacrum[20]. Avulsion of vessels by violent traction is produced in vertical shear injuries**.**

CLASSIFICATION

CLASSIFICATION

The main goal of classification is to aid in the management of the injured patients**.**

Historical considerations

The French surgeon Joseph Francois Malgaigne (1806–1865) was the first to describe a classification system for pelvic fractures as early as the 19th century. There are more than 50 classifications but most of them are in descriptive nature. Pennel and Sutherland in 1961 reported that typical and reproducible injury patterns are produced by major force vectors. Tile modified original Pennel classification and his classification system was entirely based on force vector. The Young-Burgess[31] classification is same as Pennel with addition of complex group.

Initially the instability as not addressed in classification. In 1988, a classification based on the concept of force vector and stability was put forward by Tile. At last the classification followed worldwide is modified Tile`s classification adopted by AO working group.

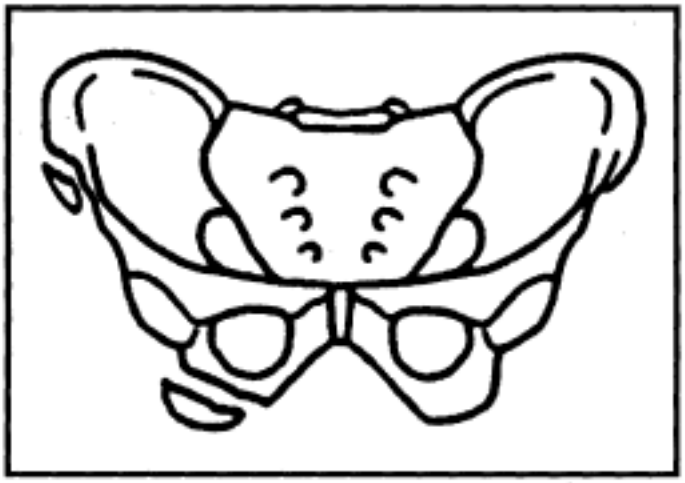
AO comprehensive classification[30] (Muller et al. 1999)

The injuries are categorized in the order of increasing severity and resulting instability, into three major types A, B and C.

TYPE A :

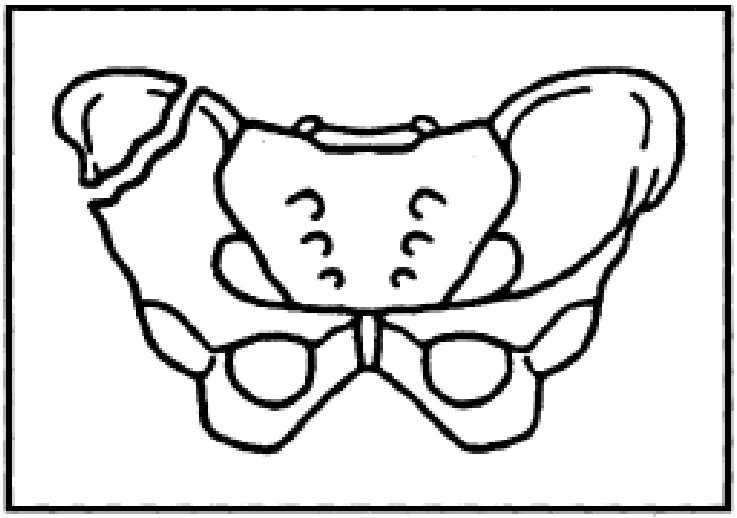
Type A fractures are stable injuries with no major instability of the posterior ring.

A1 - avulsion fracture



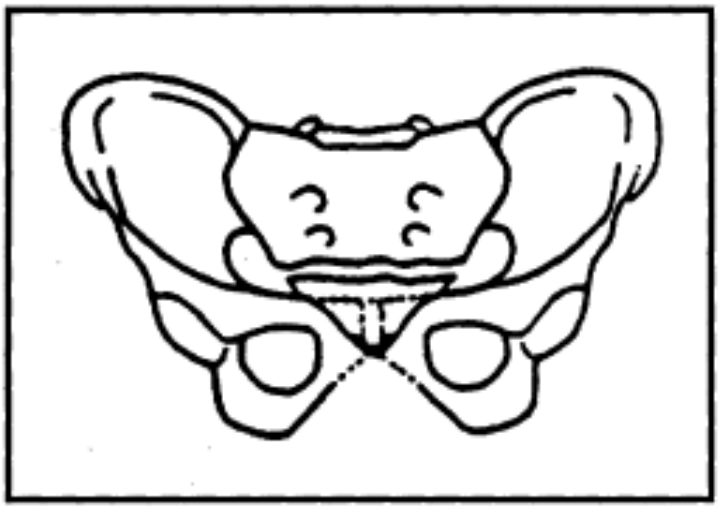
A1

A2 - stable iliac wing fractures or minimally displaced fractures of the pelvic ring.



A2

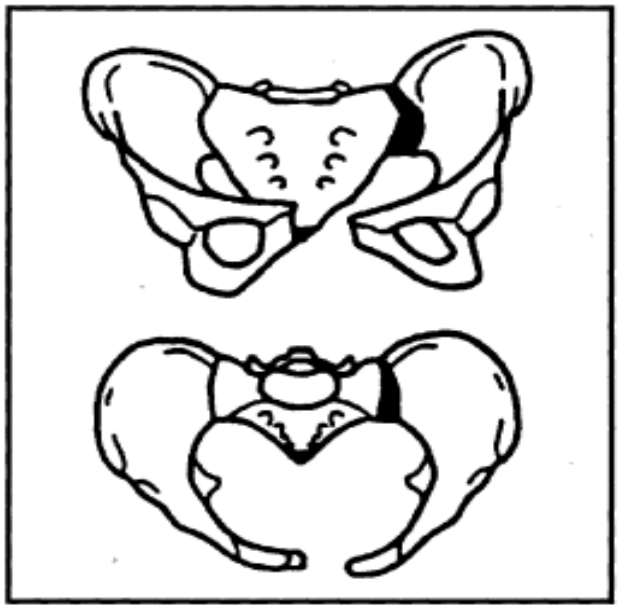
A3 – transverse fractures of the coccyx and sacrum



TYPE B PARTIALLY STABLE

These fractures are rotationally unstable but vertically and posteriorly stable.

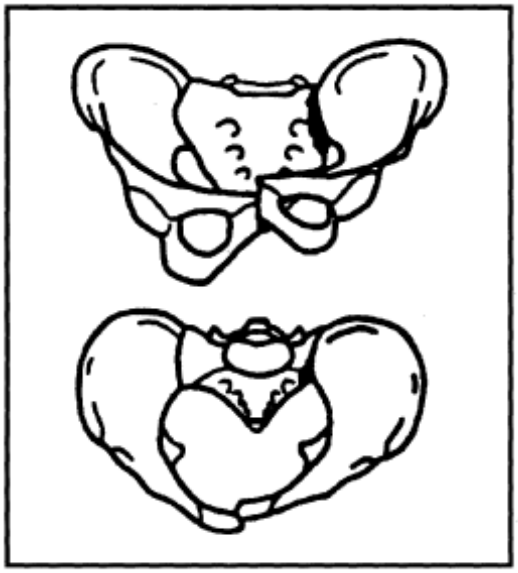
B1 – the open book injury (external rotational instability)



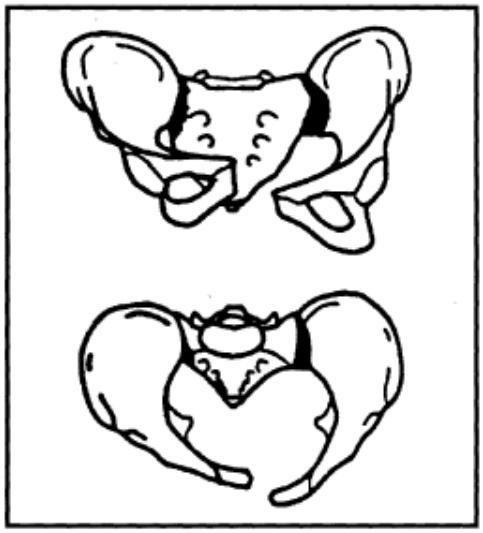
B2 – the lateral compression injuries (internal rotational instability)

B2 – 1: ipsilateral anterior and posterior injuries

B2-2: contralateral anterior and posterior injury (bucket handle)



B3: bilateral B type injuries



TYPE C UNSTABLE

The type C unstable injury is a complete disruption of the posterior sacroiliac complex, involving vertical shear forces.

C1 unilateral

C1-1: fracture of the ilium

C1-2: sacroliliac dislocation or fracture dislocation

C1-2a1: dislocation of the anterior aspect of sacroiliac

Joint with a posterior iliac fracture

C1-2a2: pure dislocation of sacroiliac joint

C1-2a3: fracture of sacrum associated with sacroiliac

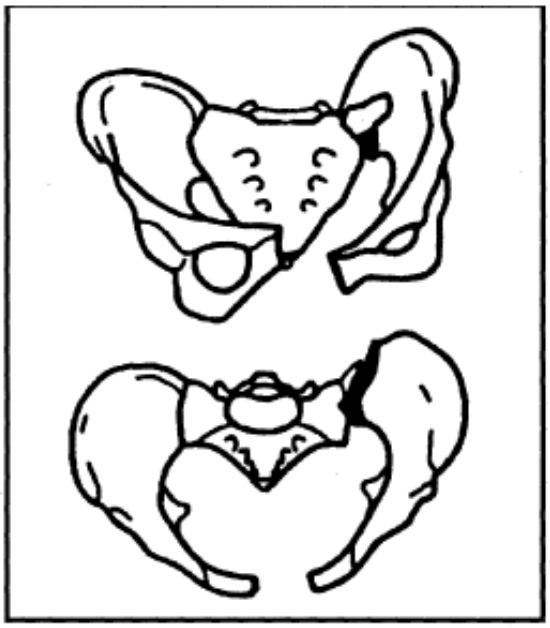
Dislocation

C1-3: fracture of the sacrum

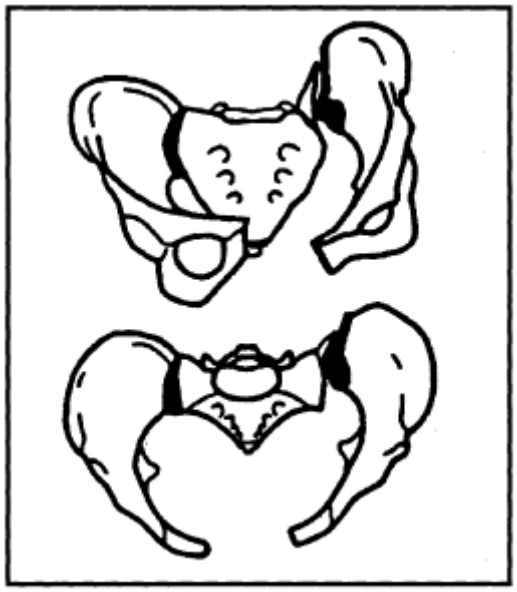
C1-3a1: fractures occurring lateral to sacral foramina

C1-3a2: fractures occurring through sacral foramina

C1-3a3: fractures occurring medial to sacral foramina

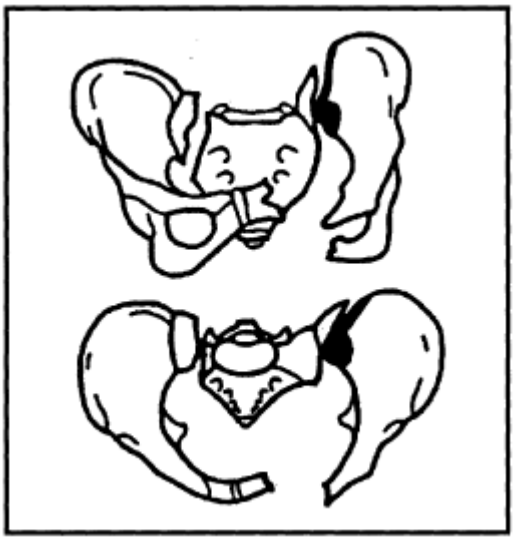


C2: bilateral, one side type B, the other side type C



C3: bilateral, both sides type C.

C3 variant: bilateral sacroiliac dislocations with an intact anterior arch.



Crescent fracture

When the posterior pelvic disruption passes through the lower portion of the sacroiliac joint and exits through the ilium, this is known as a "crescent fracture." A portion of the iliac wing remains attached to the

sacrum by means of the sacroiliac ligaments. The piece of bone fractured from the iliac wing resembles a crescentic moon, hence the term. The most common mechanism of injury is lateral compression, resulting in the wing being impinged against the dense sacral bone. These fractures are rotationally unstable, and are classified as lateral compression type II in theYoung–Burgess classification system

Jones Classification for Open Pelvic Fractures[32]

The Jones classification of open pelvic fractures refers to pelvic ring stability and rectal injury. Based on a retrospective multicenter analysis, three distinct categories

where differentiated:

Class 1: Stable open pelvic ring fractures (low mortality)

Class 2: Unstable open pelvic ring fractures without rectal injury (about 33% mortality)

Class 3: Unstable open pelvic ring fractures in combination with rectal injury (up to 50% mortality)

CLINICAL &

RADIOLOGICAL

EVALUATION

CLINICAL ASSESSMENT

Most of the patients with sacroiliac joint disruptions are polytrauma patients[31], hence clinical assessment begins with general assessment. Initially a rapid primary survey[32] is done for 3-5 minutes assessing the airway, bleeding and CNS status. If there is hemodynamic instability it should be followed by resuscitation and then a detailed secondary survey is done with thorough skeletal examination, GIT, CNS and excretory system examination.

History assumes importance as it gives an idea about the direction and magnitude of injuring force[34] on which the degree of instability and classification depends.

Inspection

Clinical inspection of the patient is more important than other investigation. Thorough inspection, looking for the external injuries, wounds, contusions and bruises[32]. The genitalia must be inspected for any bleeding. The attitude of the patient indicates the displacement of pelvis mostly. Look for pelvic asymmetry and limb length difference and finally look for bleeding in meatus indicating urethral injury[32,34].

Palpation

Palpation is painful and it is ideally done under anaesthesia. Pelvic compression and distraction test[33], bitrochantric compression test, palpation of sacroiliac joint, pubic symphysis and knee joints should be palpated. The integrity of distal neuro-vascular structure[20] must be examined. For instability or impaction, pelvic traction test done and finally to rule out occult open injuries rectal and vaginal examination should be done.

RADIOLOGICAL ASSESSMENT

The standard protocol is to have the following three views of pelvis.

AP view

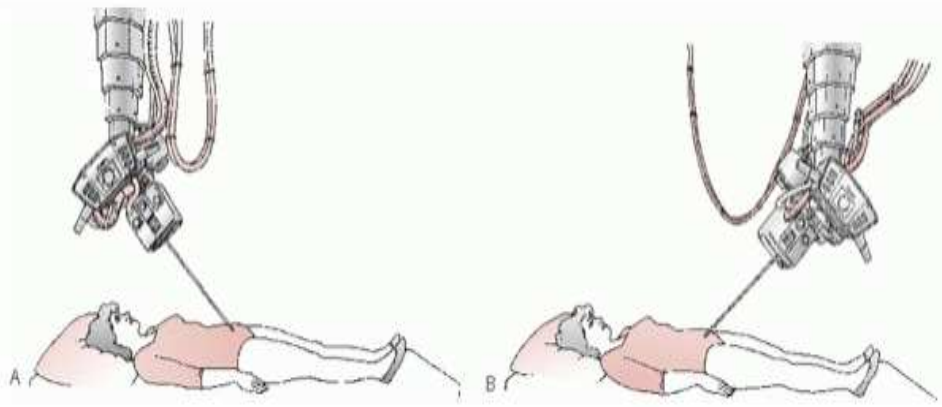
The standard AP view is taken with the patient supine and the X-ray beam directed perpendicular[26] to the mid pelvis. Lot of information about both anterior and posterior lesions can be obtained from AP view. Other telltale signs of instability life displaced avulsion fracture of either end of sacrospinous ligament, avulsion fracture of tip of L5 transverse process may be evident.

Inlet view

This view is obtained with the patient lying supine and the x-ray beam directed from the head to mid pelvis at an angle of 45 degree[26,34] to the x-ray table. In this true pelvic inlet view the anterior and posterior displacement of pelvis seen at the best**.**

Outlet view

This view is obtained with the patient lying supine and the x-ray beam directed from foot to symphysis at an angle of 45 degree[32,33] to the radiographic plate. With this view superior displacement of the posterior of the pelvis and either superior or inferior displacement of the anterior portion of pelvis can been made out.



PELVIC INLET AND OUTLET VIEW

Oblique view

This view particularly oblique view through the sacroiliac joint may sometimes helpful in determining the displacement either fracture or dislocation.

Computed tomography

CT scan is the investigation of choice[34] for mainly assessing the stability of posterior sacroiliac joint. It gives clear demarcation between the impacted and stable or disrupted and unstable. Three dimensional reconstruction of pelvis helps in appropriate management of the injury.

Nuclear scanning

There is only limited value for nuclear scanning with technetium, getting deposited in the subchondral bone of sacroiliac joint in osteoblastic areas suggesting microavulsion fracture of subchondral bone[34].

INVESTIGATIONS FOR ASSOCIATED INTRAPELVIC SOFT TISSUE INJURIES

Angiography

It is both diagnostic and therapeutic[28]. Angiography helps on locating the bleeding vessel and it can be also used in embolizing the vessel in management. It is indicated mainly when ther is no improvement in hemodynamic status of the injured patient even after resuscitation and external skeletal stabilisation.

Ascending cystourethrogram

Helpful in cases of bladder and urethral injuries, to locate the site of injury and its type, whether partial or complete.

MANAGEMENT - APPROACHES &TECHNIQUES

MANAGEMENT PROTOCOL

General assessment

The protocol of Advanced Trauma Life Support (ALTS)[34] should be followed for general assessment, resuscitation and for diagnosing skeletal and associated injuries. This is followed by thorough clinical survey of sacroiliac joint injury for its stability and its associated soft tissue injuries. Finally radiological workup of the patient done.

Decision making

Basically four scenarios exist for sacroiliac joint injuries based on patient hemodynamic stability and the stability of injury[26].

1. Stable hemodynamic and stable sacroiliac injury
2. Unstable hemodynamic and stable sacroiliac injury
3. Stable hemodynamic and unstable sacroiliac injury
4. Unstable hemodynamic and unstable sacroiliac injury

In patients with both hemodynamic and injury is stable, it is necessary to confirm the stability of the injury and to mobilise the patient with the subsidence of symptoms.

Aggressive resuscitation[32] should be done for hemodynamically unstable with stable sacroiliac joint injured patients and once the general condition of the patient is stabilised then definitive management of

sacroiliac disruption planned. If the displacement is minimal conservative management followed and if there is much displacement with unacceptable deformity early closed or open reduction and internal fixation planned.

Close observation[34] for 18 to 36 hours with upper tibial pin traction for patients with vertically displaced unstable sacroiliac disruption and stable hemodynamic is followed. This is mainly done to ensure that there is no further bleeding.

The management of patients with both hemodynamic and sacroiliac joint instability is a challenging problem. First, the patient is resuscitated and if necessary embolization[28] of bleeding pelvic vessel is done to arrest the bleeding. Applying a non invasive pelvic stabilisation set[32] like pelvic belt along with upper tibial pin traction and conventional external fixator frame can be done as a part of resuscitation. Once the patient become stable definitive fixation planned.

DEFINITIVE FIXATION OF SACROILIAC JOINT DIRUPTIONS

Treatment options available

1. Percutaneous iliosacral cannulated cancellous screw fixation
2. Open reduction internal fixation with iliosacral cancellous screws.
3. Open reduction and internal fixation with reconstruction plate through anterior intra pelvic approach

4. Open reduction internal fixation with reconstruction plate through posterior extra pelvic approach.

SURGICAL APPROACHES TO SACROILIAC JOINT

The pelvic ring links the axial skeleton to the lower limbs, anchors the major muscle groups of the anterior abdominal wall, lumbar spine and lower limbs, protects and provides routes of transit for the lumbosacral plexus, and finally, suspends the organs of the perineum[26]. It is therefore hardly a surprise that surgical approaches to the pelvis are technically demanding, and carry a risk of iatrogenic injury[37]. These may be due to intraoperative trauma to important neurovascular structures during exposure, reduction, or fixation, or related to wound breakdown. The choice of an appropriate surgical approach represents the prerequisite for an adequate outcome after surgical fixation of unstable pelvic ring injuries[40]. This is of particular importance due to the imminent risk of iatrogenic intraoperative damage of neurovascular structures or wound healing problems by posterior approaches due to the thin dorsal soft tissue coverage of the sacrum and sacroiliac joint. Successful surgical exposures of the pelvic ring strictly depend on a correct preoperative positioning of the patient on the operating table. The use of bolsters, staples of sheets, or supports mounted to the operating table alleviate the approach and exposure of the fracture site.

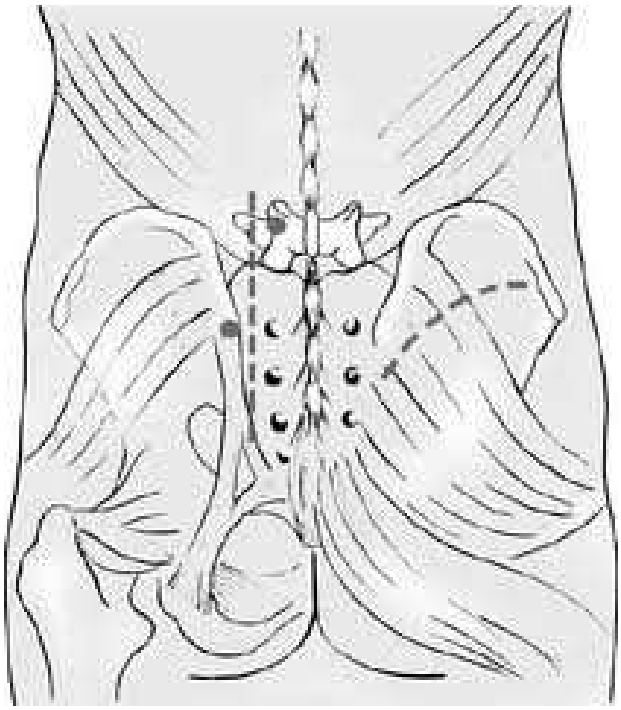
Before skin incision, anatomical landmarks should be identified and marked. A strict subperiostal dissection technique helps avoiding damage to neurovascular structures. Furthermore, the careful blunt detachment of musculature from the bone helps maintain the integrity of the muscle and protect neurovascular structures[26]. An appropriate surgical approach contributes to minimal tissue trauma, offers good intraoperative exposure, enables short operating times, and minimizes the risk of iatrogenic tissue damage.

Anterolateral intrapelvic approach

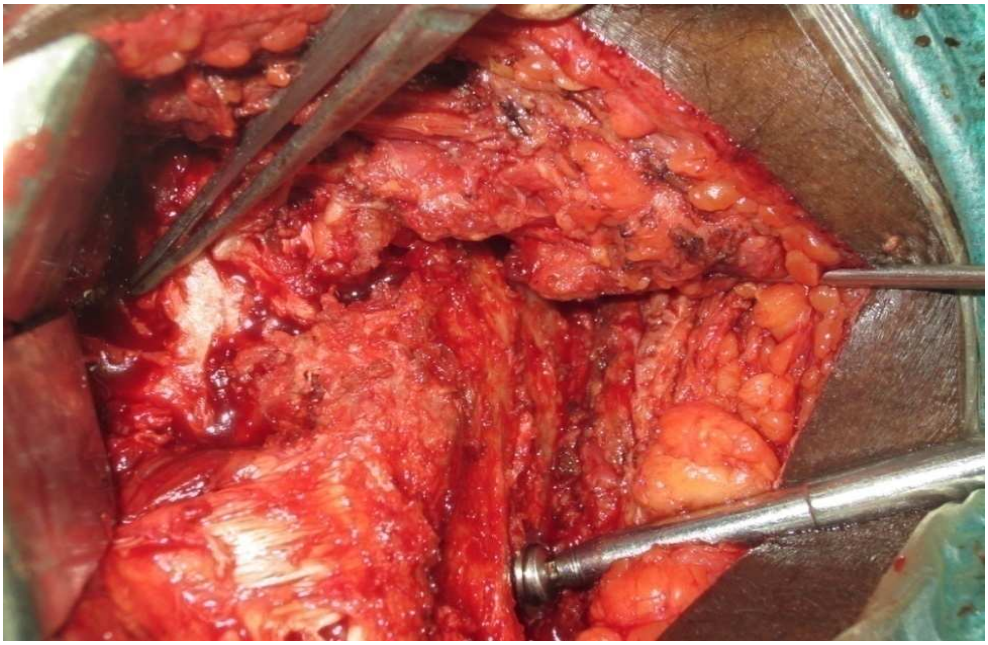
The anterolateral Olerud approach[36], corresponding to the first window of the ilioinguinal Letournel approach[40] allows direct access to the anterior part of the SI joint. Apart from excellent direct visual control of these anatomical structures, optimal guidanceof the drilling direction close to the SI joint is possible.

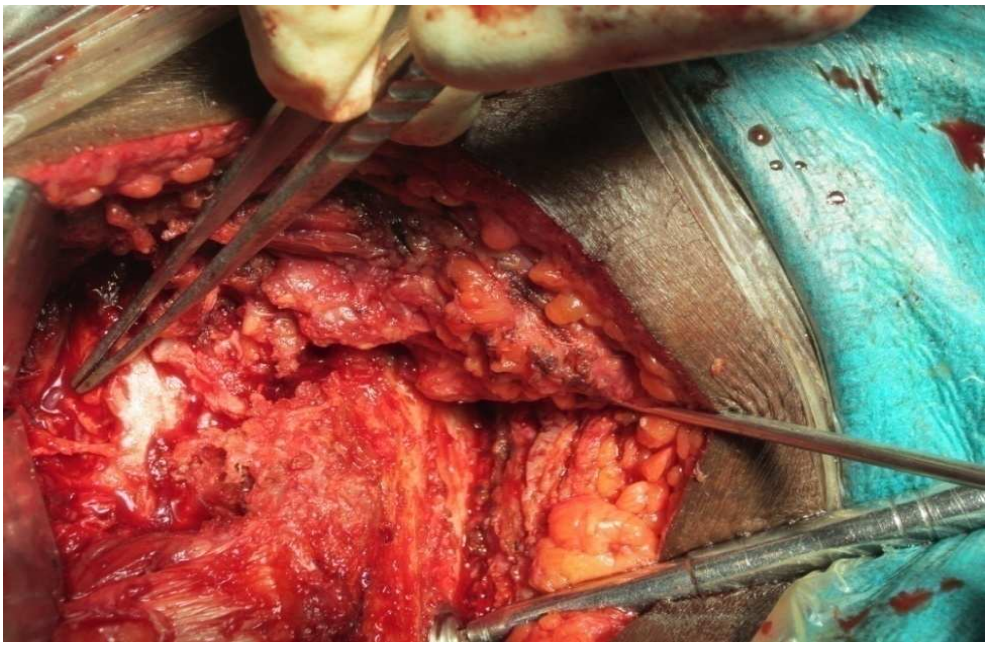
The incision is made along the iliac crest from 4 cm proximal[36] to the highest point of the iliac crest to a point just distal to the anterior superior iliac spine and curved ventro medially for another 5 cm along the line of inguinal ligament. Aponeurosis of external oblique muscle erased from iliac crest subperiosteally[36]. The lateral femoral cutaneous nerve[40] which runs ventrally towards anterior superior iliac spine should be spared. Bleeding from avulsed nutrient vessels in iliac bone is sealed with bonewax[26]. Blunt dissection is carried out subperiosteally along the internal iliac fossa, down to the pelvic brim and sacroiliac joint. The iliacus and psoas muscles are retracted medially and the joint is dissected clean with exposure of ala of sacrum. Major risk in this approach is injury to L5 nerve root[26] which is avoided by staying close to sacroiliac joint on the sacrum.

Posterior extrapelvic approach



The approach is safe with regard to neurovascular structures since there is no true internervous plane[35]. It has to be taken into account, however, that the prone positioning may not be adequate in acute cases for patients with concomitant severe intracerebral, intraabdominal, or thoracic injuries[26]. The specific risks of posterior approaches are represented by the endangered soft tissue envelope and the possibility of inducing iatrogenic lesions to the sacral nerve roots by incorrect reduction or fixation techniques of the SI joint. The thin soft tissue coverage[35] puts the posterior approach at risk for delayed or impaired wound healing and subsequent infections. The patient is placed prone on the operating table.





A straight skin incision is made beginning 1 to 2 cm proximal and lateral to the posterior superior iliac crest[35] and extending vertically down to just distal to the level of the sciatic notch. Undermining of the skin edges must be avoided. The gluteus maximus is then identified and released from

its origin on the iliac crest, sacrotuberous ligament, and also the muscle fibers, which are continuous with those of the erector spinae. The gluteus maximus is then reflected subperiosteally[40] from the ilium, along with medius and minimus, as far as the iliac tubercle.

The dissection is then extended distally to expose the posterior inferior iliac spine and the inferior aspect of the SI joint. The superior gluteal artery is at risk as it exits the greater sciatic notch[35]. Great care should be taken during this dissection to prevent injury to the artery and its accompanying nerve. Similarly, excessive retraction on the gluteal muscle mass must be avoided.

The piriformis muscle is then identified in the greater sciatic notch and mobilized to allow a finger to be inserted into the notch and allow palpation of the anterior aspect of the SI joint[40]. Release of a portion of the sacrotuberous ligament may be necessary to allow adequate exposure. Further elevation of the erector spinae and multifidus muscles towards the midline allows the dorsal surface of the sacrum to be exposed if necessary.

REDUCTION AND FIXATION TECHNIQUES

Posterior approach

The open approach to the posterior pelvic ring requires that the patient be placed in a prone position on bolsters. All components of anatomy should be identified[26], including the sacral neural foramina, the ala, and the superior aspect of the first sacral vertebra. The sacroiliac joint should be debrided and aligned anatomically. In case of sacroiliac joint disruption, bone reduction clamps are used to bring the ilium into correct alignment with the sacrum across the joint[26,38]. Similarly, clamps can be used to align sacral fractures. Reduction is best judged with fluoroscopy and direct visualization. The anterior aspect of the sacrum is palpable through the greater sciatic notch[26], allowing the surgeon to assess the alignment of the disrupted joint.

Once the reduction is achieved internal fixation can be done with either cancellous screw or with reconstruction plate and 3.5 mm screws. Preferably two 6.5 mm iliosacral lag screws are used, and ideally insaerted into the body of S1. The entry point for the screws is on the either side of the midpoint of a line running from the iliac crest to the greater sciatic notch approximately 15 mm anterior to and paralleling the crista glutea and oriented at right angle to the surface of the ilium[35,26].

Permanent fixation can also be achieved by plate fixation. Screw placement can be difficult due to both the tight confines of the approach and the anatomy of the sacrum. Examination of the field during fixation with fluoroscopy will make screw placement easier. One advantage of plate fixation is that the plate can be used as a reduction tool by over contouring. Either 3.5 or 4.5 mm plates can be used.

Advantages and disadvantages

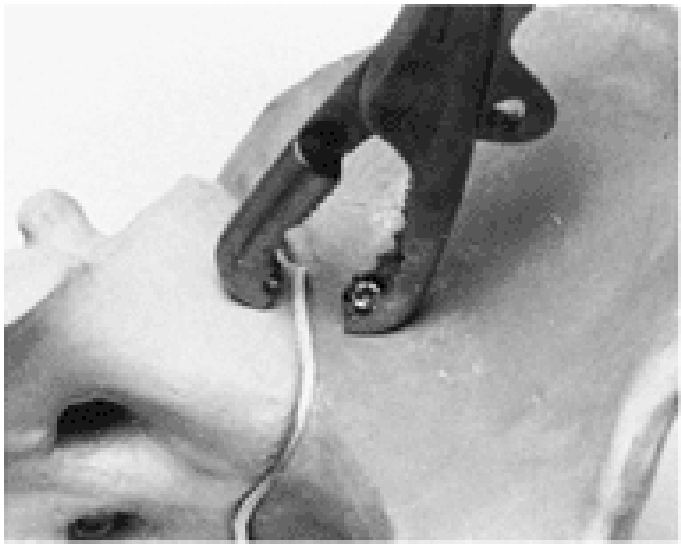
The advantage is good visualisation of the sacroiliac joint and good reduction can be achieved. The disadvantage is wound dehiscence[26]. In patients with severe soft tissue injury it is contraindicated.

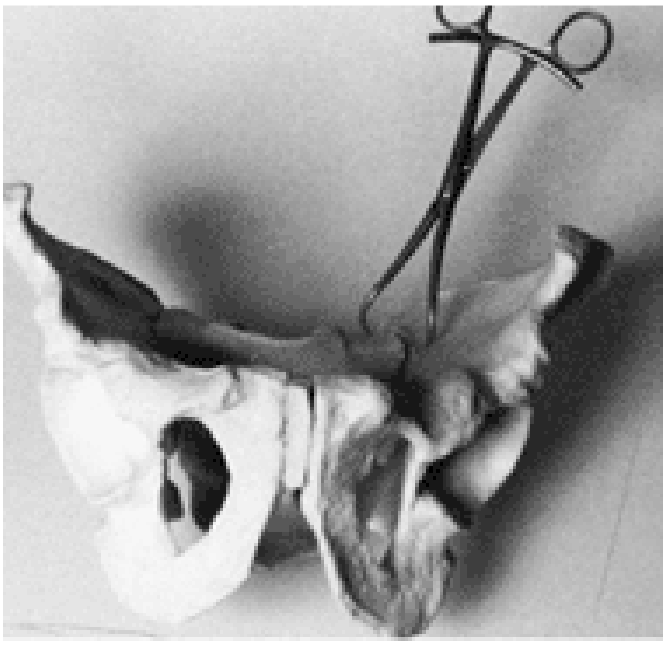
Anterior approach

For anterior exposure of the sacroiliac joint, the patient is placed supine with the injured side tilted up with a roll for easier access and manipulation.

The limb is draped free so it may be manipulated into flexion to relax the iliopsoas muscle[40]. In most dislocations, the ilium is displaced superiorly and posteriorly, so reduction requires that the hip be flexed and pulled with inline traction. A pelvic reduction clamp can be placed from the sacral ala to the ilium along the inner table[39]. To help bring the ilium into place, a shanz

pin placed in the ilium can be used to aid manipulation. The sacroiliac joint can be held in place temporarily with kirshner wires or a staple[26].





Once adequate reduction is obtained, permanent fixation is commonly achieved using one or two plates. Screw placement can be difficult due to both the tight confines of the approach and the anatomy of the sacrum[39]. Examination of the field during fixation with fluoroscopy will make screw placement easier. One advantage of plate fixation is that the plate can be

used as a reduction tool by over contouring. Either 3.5 or 4.5 mm plates can be used.

The major disadvantage of this technique is the amount of deep exposure required and the risk to large neurovascular structures[39]. There is good ability to reduce the sacroiliac joint when using this approach. Ability to reduce the joint is reported to have 85% to 95% success if attempted within the first two weeks. The major disadvantage of this approach is the dissection required, with major neurovascular structures at risk.

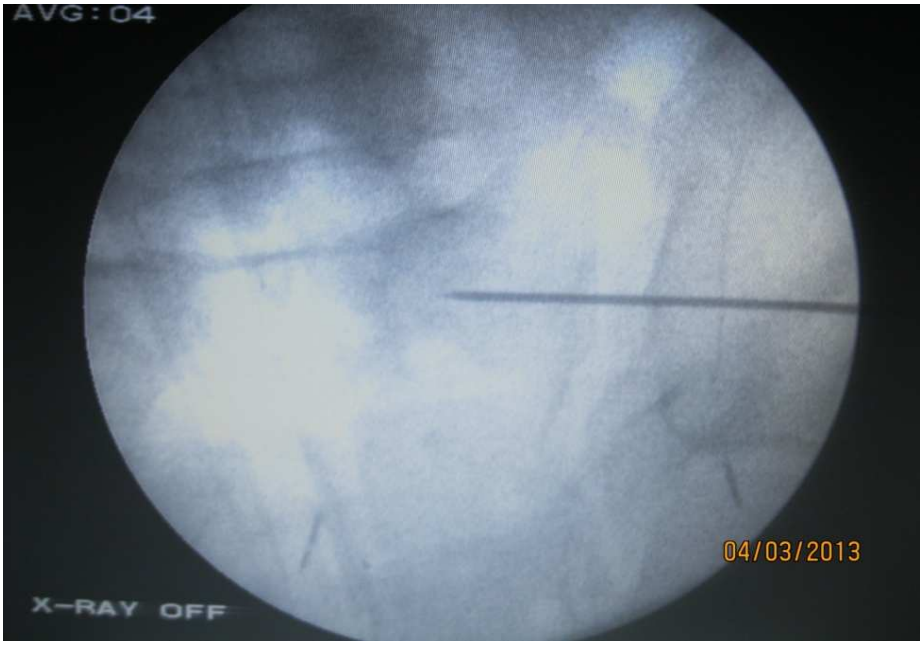
The fifth lumbar-nerve root limits medial dissection and can be damaged by dissection or retraction. Reduction and visualization of the injured structures are limited by the confines of this approach[26]. As noted previously, a problem with the anterior approach is the rate of lateral femoral cutaneous nerve injury. Up to 30% of patients are observed to have injury to this nerve, with 50% of them reporting pain or numbness at one year.

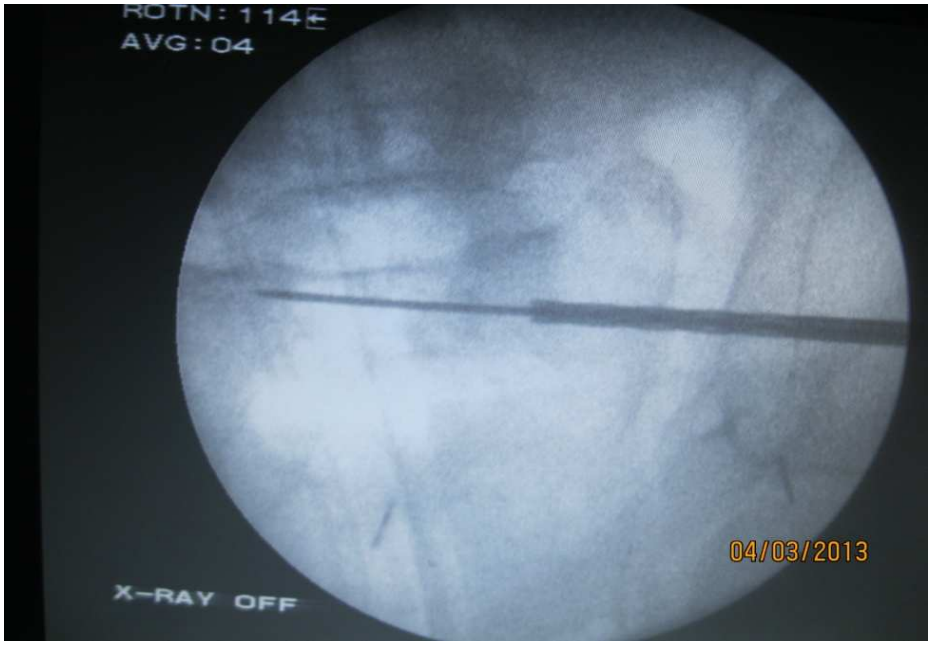
PERCUTANEOUS ILIOSACRAL SCREW FIXATION

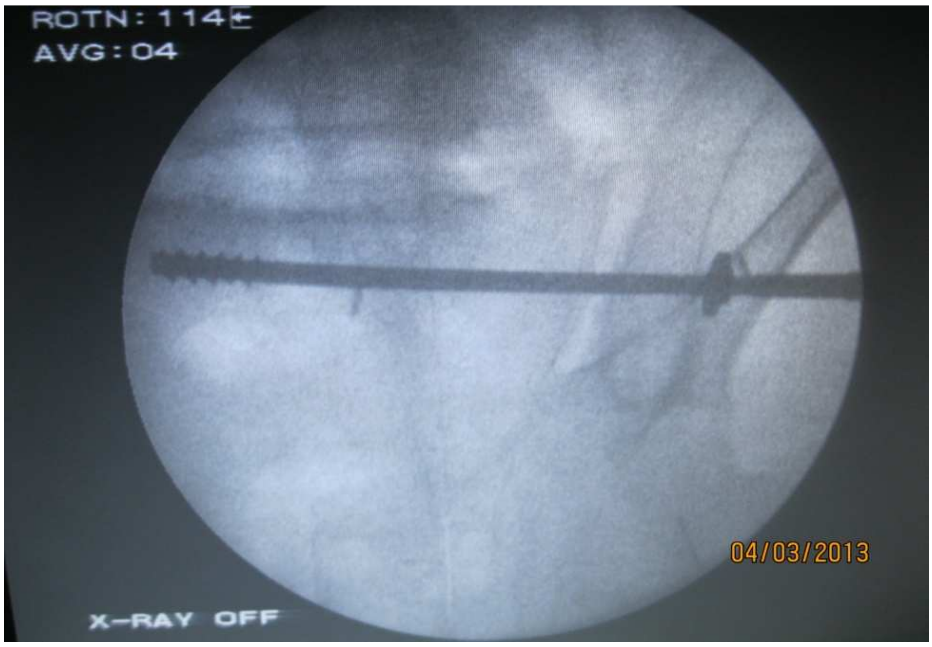
Percutaneous techniques were introduced with the aim of decreasing morbidity and mortality to the patient while maintaining a rigid and anatomic reduction[37]. Intraoperative assessment of fracture reduction and percutaneous insertion of screws has become possible with improvements of imaging technology and an improved understanding of sacral anatomy. This technique was popularized by Routt and associates, who were the first to report on a large series of patients operated in the supine position.

With the patient in supine position, the entire lower abdomen is draped free from the nipple line distally, including the involved leg in case traction is required. A midline radiolucent bump is used to lift the buttock off the bed to achieve a better entry point[39]. Prior to draping, fluoroscopy is used to ensure that adequate anteroposterior, inlet, and outlet views are visible. Preoperative images are assessed to ensure nothing is obscuring the sacral body or neural foramina. Contrast in the abdomen or nitrous oxide inhalational anaesthesia can obscure anatomic details and make the procedure more difficult[26]. Nitrous oxide passes readily through the endothelial capillaries of the intestine and enters the bowel lumen. The resulting gas bubbles can mimic or obscure outlines of neural foramina; the procedure will have to be delayed by three to five days until the gas settles.


04/03/2013


AVG : 04
04/03/2013
X-RAY OFF





To approximate the entry point, one can view a direct lateral of the sacrum and trace out the dorsal and ventral aspects of the sacrum along with the superior endplate of S1 on the skin[26]. This triangular shape demarcates the sacrum, the target for guidewire placement.

A cannulated bone spike helps maintain guidewire position on the ilium and also helps with reduction of lateral displacement. Before inserting the guidewire, a maneuver may be required to reduce the sacroiliac joint. The lateral fracture fragment is usually displaced superiorly and posteriorly. The best way to reduce this is to apply mild traction while the hip is held in flexion. Depending on the mechanism of injury (either lateral compression or anterior–posterior compressions), the leg may need to be abducted or externally rotated to reverse the deforming forces with continuous traction. If the reduction is difficult, a shanz pin placed in the ilium can aid manipulation. This can be used as a joystick to maneuver the hemipelvis into a reduced position[26,39].

Once reduction is obtained, the guidewire is inserted through the cannulated bone spike. The position is first checked on the outlet view to make sure the wire is aiming above the first sacral foramen[37]. The inlet is then verified to ensure to wire is aimed toward the first sacral body[37]. The position of the guidewire can also be checked by aiming the beam of the C-arm directly down the axis of the wire on a direct lateral view. The wire should lie caudal to the iliac cortical density and within the borders of the anterior and posterior bony margins of the sacrum. In general, the wire should be passed as far as safely possible, as this will increase screw

purchase and hopefully decrease risk of failure. Once guidewire position is adequate, the length of the wire should be measured[26,39].

Partially threaded 6.5 mm cancellous screw is used. Washer is used when the degree of compression required is more. Usually one screw is enough but for highly unstable dislocation two screw may be required. The placement of second screw in S1 may be difficult, so it may be inserted in S1 body. 30% patients have dysmorphism of S1 body, in such cases screw is placed in S2 body. Somatosensory evoked potentials during fixation to guard against nerve injury may be used.

Advantages

1. Decreased soft tissue dissection
2. Decreased blood loss
3. Less operative time
4. Cost effectiveness
5. Less wound healing problem

Reduction and fixation techniques for crescent fracture

Traditionally, these fractures have been stabilized with open reduction and internal fixation. They can be approached anteriorly, via an iliac fossa approach, or posteriorly, by elevating the gluteus maximus to expose the posterior ilium. These open approaches are beneficial in that they

allow direct manipulation of bone fragments. As noted by Routt, the posterior approach allows for debridement of devitalized muscle tissue disrupted by the injury[26]. Reports of open reduction and internal fixation of crescent fractures have shown uniformly good results. But, as with other open procedures, open reduction of crescent fractures carries a moderate risk of soft tissue complication. Due to the risk, percutaneous methods have been attempted for this injury pattern. The injury mechanism is often a lateral compression, which results in internal rotation of the hemipelvis. External rotation and abduction of the hip often serve to correct the deformity in percutaneous fixation[26,39].

.

MATERIALS

AND

METHODS

MATERIALS AND METHODS

Place of study : Rajiv Gandhi Government General Hospital, Chennai

Type of study : Retrospective and prospective study

Sample size : 21

Period of study: October 2011 to October 2013

INCLUSION CRITERIA

- Hemodynamically stable patients
- Closed fractures
- Fracture dislocations(crescent fracture)
- Associated with other pelvic injuries(iliac wing fractures, acetabular fractures, etc)
- Rotationally unstable B type injuries(bucket handle type)
- Rotationally and vertically unstable type C injuries.

EXCLUSION CRITERIA

1) Hemodynamically unstable patients
2) Open injuries
3) Uncooperative patients for postoperative rehabilitation
4) Stable pelvic injury(type A injuries)

PREOPERATIVE EVALUVATION

In acute presentation of patients with sacroiliac joint disruption, ATLS protocol was followed. All hemodynamically stable patients were subjected to the following

- ❖ Detailed clinical examination
- ❖ Complete haemogram
- ❖ Renal function tests
- ❖ Radiographs of the Pelvis (Antero-posterior, Inlet and Outlet views).
- ❖ CT pelvis with 3D reconstruction
- ❖ CT KUB with contrast for suspected bladder/urethral injury
- ❖ General surgeon and urologist opinion

SURGICAL TIMING

All stable patients with unstable sacroiliac joint disruptions are taken for surgery for internal fixation electively after 24 to 48 hours of injury.

IMPLANT SELECTION

Procedure	Implant used
Closed reduction	**6.5** mm cannulated cancellous screw
Open reduction and internal fixation thorough anterior approach	Reconstruction plate with 3.5 cortical screw
Open reduction and internal fixation thorough posterior approach	**6.5** mm cannulated cancellous screw

CHOICE OF APPROACH

In patients where closed reduction of the joint is obtained and not associated with other pelvic fractures percutaneous fixation done. In patients where closed reduction cannot be obtained, open reduction and internal fixation done through posterior approach. In patients with associated iliac wing, acetabulum and rami fractures, antero-lateral approach used so that other fracture fixation can be done through same approach.

POSTOPERATIVE PROTOCOL[26,38]

1. Drain was removed on the 2nd post operative day with collection being less than 20 ml for a period of 8 hours. Post operatively intravenous antibiotic for 5days and oral antibiotic for another 7 days.
2. Suture removal done on 12th post operative day
3. Post operative paralytic ileus is common and addressed accordingly.
4. Oral diet started only after flatus is passed and bowel sounds returned. Postoperative bowel regime should be aggressive and it should be a part of post operative protocol.
5. Patient was mobilised from bed to chair using uninjured leg as a pivot on the 1st post operative.
6. Touchdown weight bearing for 10 to 12 weeks
7. Aid free ambulation after 12 weeks.
8. Progressive return to full activity usually began after 6 months.

FOLLOW UP

Patients were followed at 4 weeks, 12 weeks and at 6 months. At each visit patient is subjected to the following,

- Stress test of the sacroiliac joint (Faber`s and Ganselon`s test)
- Functional ability of the patient (history)
- Assesment of implants (radiographs) for:
    - Loosening
    - Infection
    - Failure

Radiographic assessment of sacroiliac joint

- AP view
- Inlet view
- Outlet view

Functional outcome of patient with pelvic outcome scale (Cole et al).

Mean follow up of all patients was 14 months

OBSERVATION

&

ANALYSIS

OBSERVATION

AGE INCIDENCE AND DISTRIBUTION

The age of the patients ranged from 16 to 58 years. The mean age was 39.3 years.

Age in years	No.of patients	Percentage
11-20	01	04.78
21-30	03	14.28
31-40	07	33.33
41-50	07	33.33
51-60	03	14.28
Total	21	100

SEX INCIDENCE

In our study, male patients predominated with male to female ratio of 18:03.

MODE OF INJURY

Majority of patients suffered road traffic accidents followed by fall from height.

Mode of injury	No. of patients	Percentage
RTA	18	85.7
Fall from height	02	9.5
TTA	01	4.8

TYPE OF INJURY (CLASSIFICATION)

Classification	No. of patients
B1	01
B2	04
B3	01
C1	11
C2	04
C3	Nil

ASSOCIATED INJURIES

In our, study 11 patients (52.4%) had associated skeletal and/or soft tissue injuries. Four patients had associated acetabular fracture and two patients had multiple associated injuries.

Associated injury	No. of patients
Fracture of shaft of humerus	01
Fracture of BB forearm	01
Fracture of scapula and ribs	02
Fracture of shaft of femur	01
Fracture shaft of tibia	01
Fracture of acetabulum	04
Posterior dislocation of hip	01
Nerve injury(L5 root)	01
Injury to urethra	01
Injury to urinary bladder	01
Head injury	01

SURGICAL PROCEDURES

Four type of surgical management in our study are as follows.

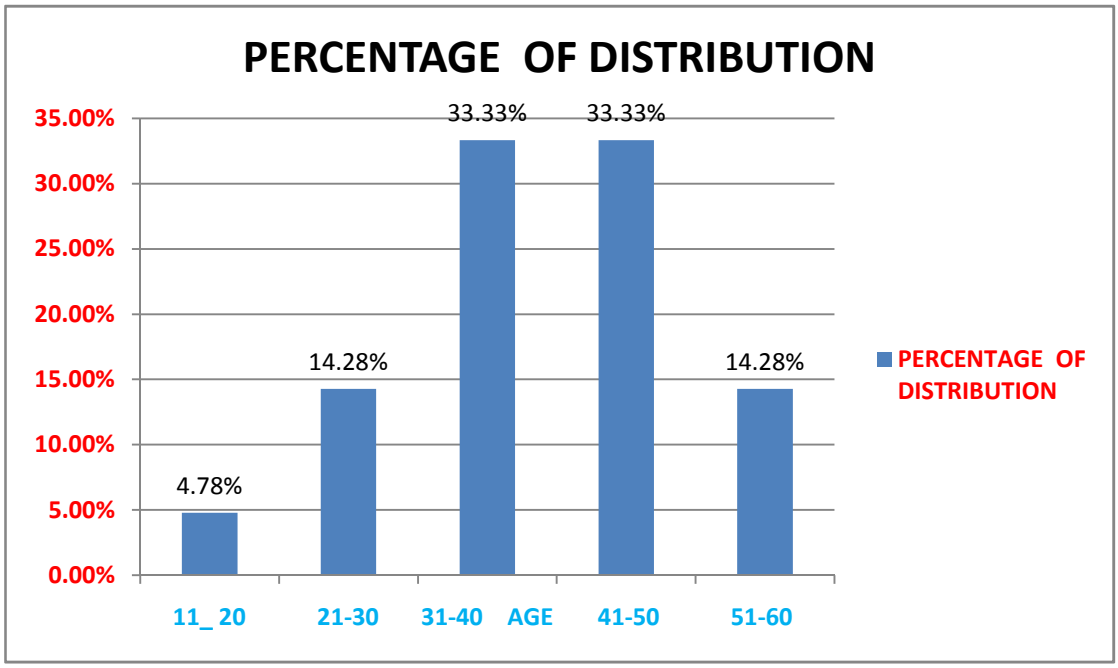
Procedure	No. of cases
Closed reduction and percutaneous iliosacral screw fixation under fluoroscopic guidance	10
Open reduction and internal fixation with reconstruction plate thorough anterior approach	06
Open reduction and internal fixation with cancellous screw through posterior approach	03
Emergency pelvic external fixation in unstable patient followed by elective percutaneous iliosacral screw fixation	03

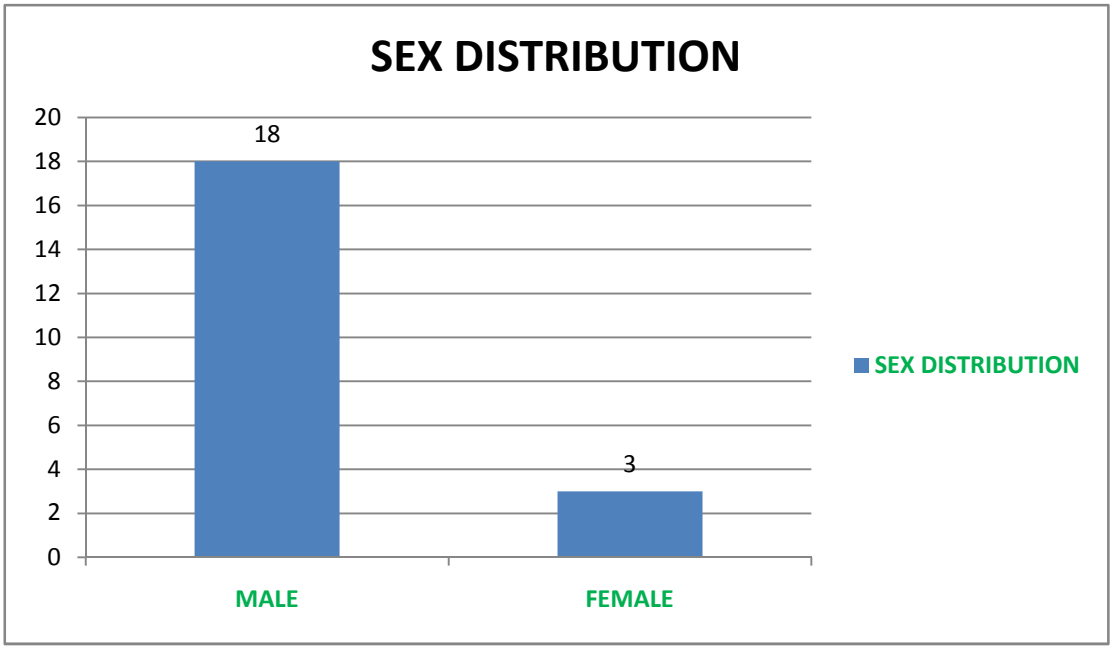
COMPLICATIONS

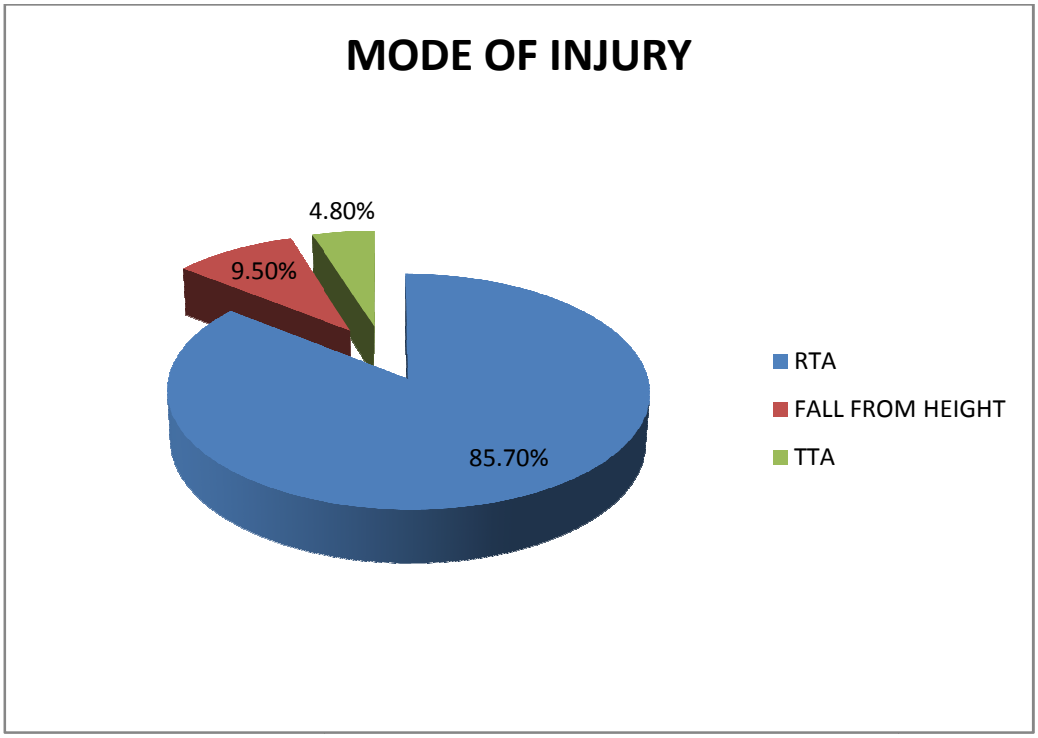
Complication	Treatment
Postoperative infection in one patient following open anterior reduction	Infection subsided with pus culture and sensitivity, appropriate antibiotic, followed by wound debridement
L5 paresis in one patient following anterior open reduction	Recovered partially with pregabalin and methylcobalamine

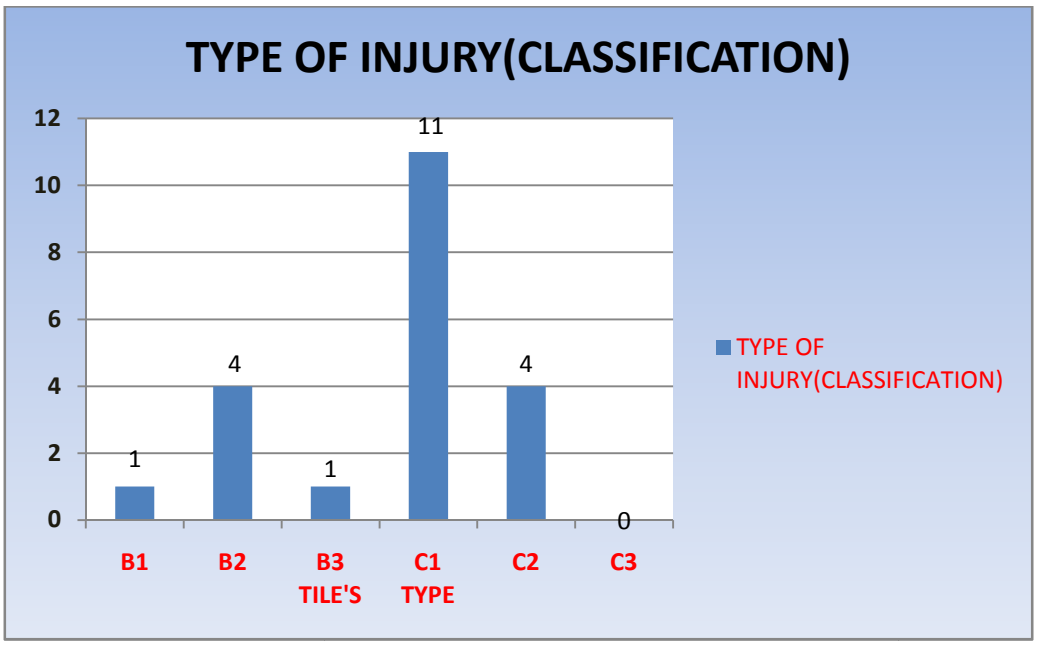
EMERGENCY SOFT TISSUE SURGERY

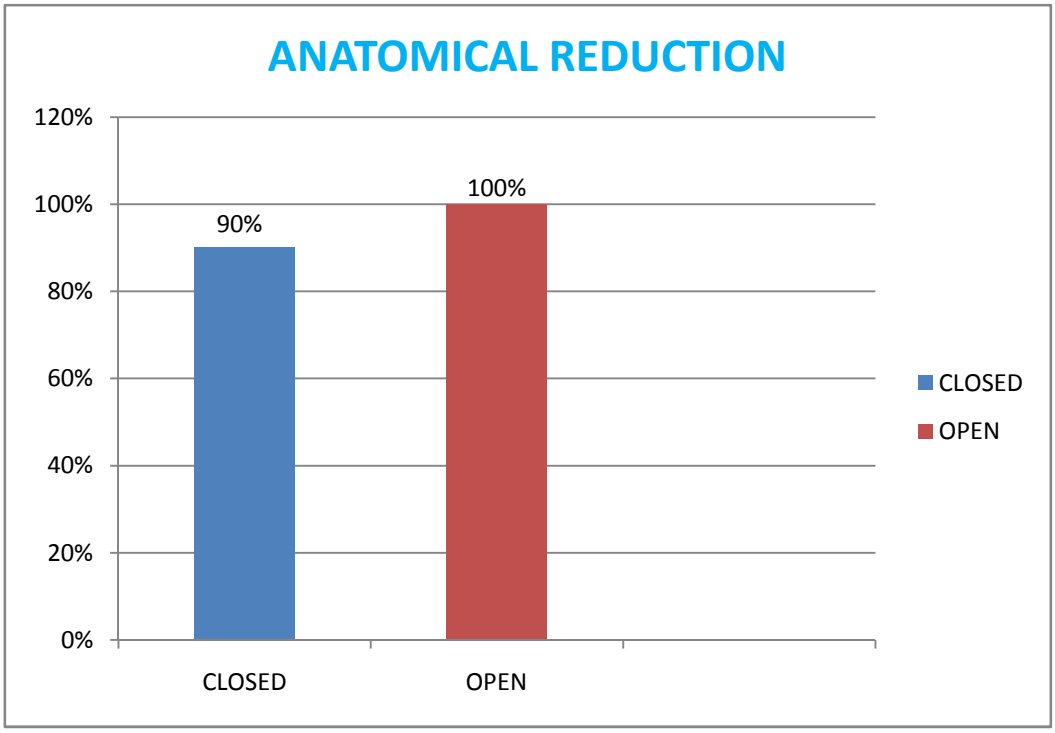
One patient with bladder injury underwent laprotomy bladder repair and one patient with urethral injury was treated with supra pubic cystostomy.

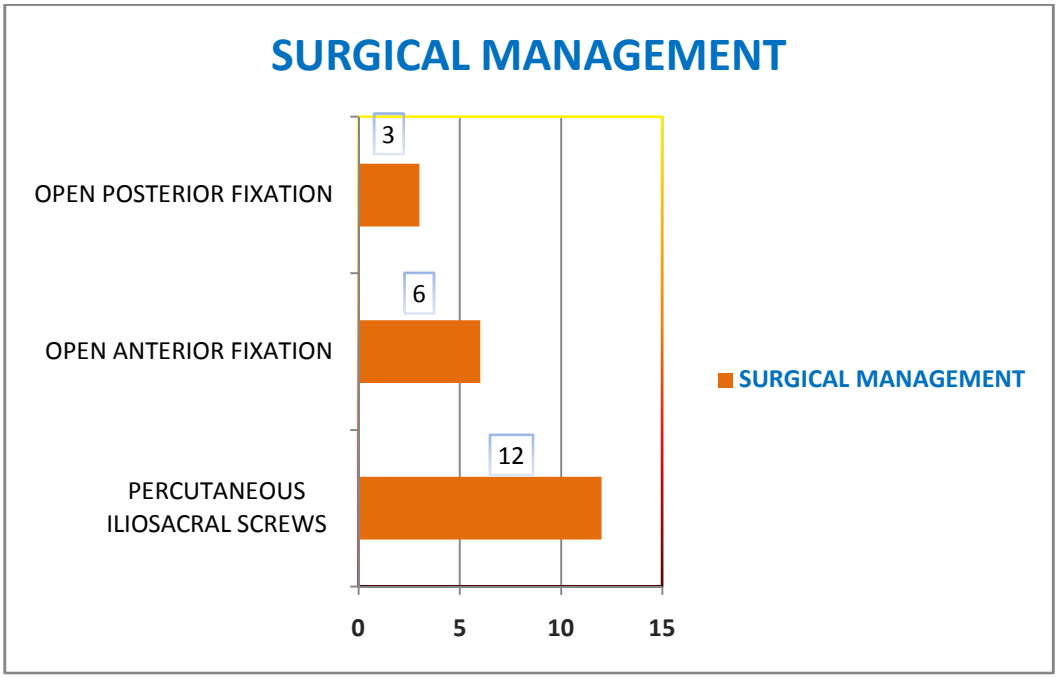

PERCENTAGE OF DISTRIBUTION
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
4.78%
14.28%
33.33%
33.33%
14.28%
11_ 20
21-30
31-40
AGE
41-50
51-60
PERCENTAGE OF DISTRIBUTION


SEX DISTRIBUTION
20
18
16
14
12
10
8
6
4
2
0
18
3
MALE
FEMALE
SEX DISTRIBUTION


MODE OF INJURY
4.80%
9.50%
85.70%
RTA
FALL FROM HEIGHT
TTA


TYPE OF INJURY(CLASSIFICATION)
12
10
8
6
4
2
0
1
4
1
11
4
0
B1
B2
B3
C1
C2
C3
TILE'S
TYPE
TYPE OF INJURY(CLASSIFICATION)


ANATOMICAL REDUCTION
120%
100%
80%
60%
40%
20%
0%
90%
100%
CLOSED
OPEN
CLOSED
OPEN


SURGICAL MANAGEMENT
OPEN POSTERIOR FIXATION
OPEN ANTERIOR FIXATION
PERCUTANEOUS ILIOSACRAL SCREWS
3
6
12
0
5
10
15
SURGICAL MANAGEMENT

FUNCTIONAL OUTCOME

Functional outcome of the patients were assessed using the pelvic outcome scale by Cole et al. it is based on a 40 point scale for pain, ambulation, work and activity status, cilinical examination and radiographic appearance

PELVIC OUTCOME SCALE (Cole et al.)

Category	Description	Points
Functional pain	Pain secondary to physical activity	
	None	5
	Pain only with strenuous activity	4
	Mild pain with stair climbing, lifting, moving, or other moderately strenuous activity	3
	Moderate pain with start up of activities and intermittent radicular pain	2
	Pain with sitting or standing longer than 1 hour, frequent position changes	1
	Chronic severe pain regardless of activity	0

Subjective pain	Average of resting and ambulation scores on a scale of 1 (no pain) to 10 (severe pain)	
	1-2 points	4
	3-4 points	3
	5-6 points	2
	7-8 points	1
	9-10 points	0
Narcotic use	Narcotic use > 12 weeks postoperatively	
	No	1
	Yes	0
Activity status	Ability to resume previous work, household, or recreational activities	
	Without limitations	10
	With some discomfort	8
	with limitations such as tires more easily or cannot lift as much as before injury	6
	With marked limitations requiring change in work status to part time,	4

	sedentary, or with restrictions; requires assistance with household activities or avoids sternous recreational activities	
	Unable to resume any previous work, household, or recreational activities; cannot drive and requires assistance with stairs and shopping	2
	Unable to resume any previous work, household, or recreational activities; requires assistance with activities of daily living	0
Physical examination	Gait	
	Normal gait	4
	Antalgic gait or limp	3
	Requires assistive device (cane)	2
	Requires assistive device (walker, occasionally uses wheelchair)	1
	Non ambulatory	0
	Trendelenberg	

	Negative	1
	Positive	0
	Tenderness	
	No sacral or pubic tenderness	2
	Sacral or pubic tenderness	1
	Sacral and pubic tenderness	0
	Lower extremity muscle group strength flexion/extension	
	Bilateral thigh flexion and extension = 5/5	1
	Thigh flexion or extension < 5/5	0
	Abduction / adduction	
	Bilateral thigh abduction and adduction = 5/5	1
	Thigh abduction or adduction <5/5	0
	Range of motion	
	Normal hip and trunk range of motion	1
	Trunk flexion <90, hip flexion <90 or >20 difference in hip internal and external rotation when	0

	compared with contralateral side	
Pelvic radiographs(AP, inlet and outlet views)	Posterior (normal sacroiliac joint space = 4mm)	
	Displacement ≤0.5 cm with sacroiliac joint reactive changes	6
	Displacement ≤ 0.5 with sacroiliac joint reactive changes	4
	Displacement > 0.5 cm and ≤ 1.0 cm	2
	Displacement > 1.0 cm	0
	Anterior (normal pubic symphysis space = 0.5 cm)	
	Displacement ≤ 0.5 cm	3
	Displacement > 0.5 cm and ≤ 1.0 cm	2
	Displacement > 1.0 cm and ≤ 2.0 cm	1
	Displacement > 2.0 cm	0

ANALYSIS OF THE STUDY

Twenty one patients with unstable sacroiliac joint disruptions were treated surgically and analysed with an average follow up of 8.7 months (range 4-16 months). The following analysis was made.

1. Two third of patients belong to fourth and fifth decade.
2. Commonly males are affected with male: female ratio of 18:3.
3. Road traffic accidents, most of them high velocity injuries were the cause in majority of patients.
4. Eleven patients (52.4%) had associated injuries, of which skeletal injuries were common.
5. One patient with associated sacral fracture had nerve palsy which recovered partially after decompression.
6. The average time delay between injury and surgery was 4.8 days (range 2-9 days).
7. The average surgical time was 76 minutes (range 40-130).
8. One patient had postoperative infection
9. Anatomical reduction was obtained in all patient. In two patients in external fixation without anatomical reduction, percutaneous sacroiliac screw was inserted to obtain anatomical reduction.
10. There is no incidence of impotence in our patients. However, clear data could not be obtained due to social and aesthetic reasons as people hesitate to reveal their sexual history.

RESULTS

RESULTS

In, our study 21 patients with unstable sacroiliac joint disruptions were treated with definitive internal fixation and followed for an average period of 8.7 months (range 4-16 months). The functional outcome of patients based on pelvic outcome scale by Cole et al was good for 18 patients and fair for two patients.

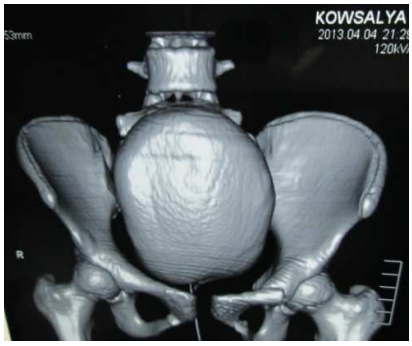
ILLUSTRATIVE CASES

ILLUSTRATIVE CASES

Case – 1:

16 year old female admitted to trauma ward with history of road traffic accident pedestrian hit by lorry. On admission patient was hemodynamically stable. Skeletal examination showed positive pelvic compression and distraction test with tenderness over right sacroiliac joint. There was no limb length discrepancy or neurological deficit. X-ray showed opening of right sacroiliac joint with left rami fracture. Patient diagnosed as bucket handle type of B2 injury and treated with percutaneous iliosacral screw. Patient had good functional outcome.

Preop x-ray and CT



Intraop fluroscopy

Postop x-ray and follow up

CASE -2

57 years old male was caught between two moving buses when he was travelling in the foot board. The patient could not move after the accident. On admission, he was hemodynamically stable. Pelvis compression test & Distraction test was positive with left sacroiliac joint tenderness. X ray pelvis shows left sacroiliac joint disruption with left acetabulam anterior column fracture. Pt diagnosed as Type C1 injury. Treated with closed reduction and percutaneous iliosacral screw for SI joint. Lag screw & buttress plating for Anterior column fracture of acetabulam. Pt had excellent functional outcome.

Preop x-ray

Postop x-ray and follow up

CASE 3:

48 years male admitted with H/o Road traffic Accident (Motorcycle Vs Lorry). On admission, patient was haemodynamically stable. On examination, pelvic compression & distraction test positive with right sacroiliac joint tenderness. Movements of right hip joint was painful & restricted. X-ray pelvis showed, type C1 injury right hemipelvis with transverse fracture of acetabulam. Pt was treated with open reduction with internal fixation of right sacroiliac joint with cancellous screw through posterior approach. Pt had good functional outcome.

Preop x-ray and CT scan

Postop x-ray and followup

CASE 4:

57 years old male admitted in trauma ward with H/o fall from height, first floor. On examination, pt was hemodynamically unstable. Aggressive resuscitation with intravenous fluids & blood done. Once the pt condition become stable, clinically examination demonstrated. Pelvic compression & distraction test was positive with tenderness and crepitus over the left sacroiliac region. X ray showed left sacroiliac joint opening with iliac wing fracture and anterior wall fracture acetabulam. Pt was treated with open reduction and internal fixation of sacroiliac joint and iliac wing through anterior ilio-inguinal approach with reconstruction plate. Post operatively, patient had L5 weakness which recovered partially and follow up. Pt had fair outcome.

Preop x-ray and CTscan

Postop x-ray and follow up

DISCUSSION

DISCUSSION

Studies on the natural history of the sacroiliac joint disruptions proved that unstable types had high mortality in acute stage and chronic morbidity in the long term[2]. Despite aggressive resuscitation including application of external fixators, the mortality of 10-20% remained unchanged. This led to clinical trials on internal fixation and several studies[3,4,8] have shown that early open reduction and stable internal fixation improves the chances of survival and more importantly, reduces the incidence of late musculoskeletal morbidity.

The mean age of the patient in our study was 39.3 years where as the Sunny Brook Medical Centre[2] series reported 30.9 years. Cole et al[5] reported an average age of 32 years. Sunil et al[6] reported on 78 cases with an average age of 29.99 years (range 10-65).there was extreme male preponderance in our series with more than 85% of male patients. The Sunny Brook medical centre[2] study reported only slight male dominance with 55%. Cole et al[5] reported male preponderance with a male: female ratio of 36.28 in 64 patients.

The most common mode of injury was road traffic accident (85.7%) in our study. Sunny Brook Medical Centre`s[2] prospective study reported 81% road traffic accidents.

Skeletal injuries was the major associated injury (52.38) with equal incidence of both acetabular and extremities fracture in our series. Sunny Brook Medical Center[2] study reported a 38% incidence of head injury as their major associated injury. Cole et al[5] reported skeletal injuries as the frequent associated injury. Tornetta et al[7] reported associated skeletal injuries in 24 of 39 patients who suffered rotationally unstable sacroiliac disruption.

Radiological assessment was done with three standard views of x-ray (AP, inlet and outlet projections) and CT scan was taken. Out of 21 patients type C injury was 15 and type B was 6. Tile`s type C1 (unilateral vertical shear) comprised of the single most common of subtype (11 cases/52.8%) followed by B2 and C2 (4 cases each). The remaining two cases are B1 and B2 (1 case each). We did not encounter any case with Tile`s type C3. Cole et al[5] in their series of 64 vertically unstable injuries reported Tile`s type C1 in 75% of cases. Miranda et al[9] in his series of 80 patients, reported 31 cases of Tile`s B type and 24 cases of C type injuries.

In our study, 10 patients were treated with closed reduction and percutaneous iliosacral cancellous screw fixation. Six patients were treated with anterior open reduction and internal fixation with reconstruction plate. Three patients were treated with open reduction thorough posterior approach and internal fixation with screws. Two patients initially stabilised with

external fixation were treated with percutaneous cancellous iliosacral screw electively. One patient treated thorough anterior approach developed postoperative infection. One patient treated with percutaneous iliosacral screw lost reduction.

82% of patients had good results following internal fixation of sacroiliac joint disruptions analysed with pelvic outcome scale in our study. Tornetta et al[12] reported on 48 patients of unstable posterior pelvic disruptions treated with open reduction and internal fixation. 67% of patients had good functional results. Cole et al[5] on 51 patients treated with posterior internal fixation for type C injuries reported that 15 patients had functional deficits with mean pelvic score of 29 points (range 8-40). In our study the mean pelvic score was 33 points.

Out of 21 patients one patient had urethral injury and another patient had bladder injury in our study compared with Sunil et al[6] reported 78 cases of which 17 patients had urogenital injuries, commonest being the urethral injury (8 cases). Miranda et al[9] reported urological injury in 15 of 55 patients with Tile`s type B and C injuries. Cole et al[5] reported on 64 cases of type C injury associated with urethral injury.

One patient in our study had L5 palsy on admission which improved to motor power of 3+ in 9 months. However, Cole et al[5] reported 19 cases of neurological injury in his series. Torenetta et al[12] reported 35% of significant neurological injury in their study of 48 unstable posterior pelvic ring disruptions.

The incidence of deep vein thrombosis in unstable sacroiliac joint disruptions was 10-80% in various studies[13,14]. We used thromboprophylaxis in patients who underwent open reduction and internal fixation thorough anterior approach.

CONCLUSION

CONCLUSION

Despite better understanding of the personality of the acutely injured sacroiliac joint disruptions and modern aggressive treatment modalities, the morbidity rate still remains high. Early aggressive but thoughtful management of the patients with unstable sacroiliac joint disruptions is essential for maximizing the immediate survival and long term functional outcome. Periodic thorough clinical and radiological assessment is mandatory to identify any occult injury. The role of team approach with various specialities cannot be over emphasized. The degree of hemodynamic instability does not correlate with type of sacroiliac joint injury. Emergent external skeletal fixation alone is not sufficient to restore hemodynamic stability in all patients who fail to improve after initial resuscitation.

Anatomic reduction and internal fixation of unstable sacroiliac joint injuries gives excellent stability, allows early mobility and good functional outcome. Percutaneous iliosacral screw fixation gives good results similar to that of internal fixation, hence open reduction is advisable only when closed reduction was not acceptable and when open approach is needed to fix other associated fractures. Percutaneous fixation was as rigid as open reduction and internal fixation. Delaying the fixation, however, increased the

difficulty of obtaining anatomical reduction. Even in delayed internal fixation good functional outcome can be obtained if anatomical reduction was achieved.

Acute management of unstable sacroiliac joint disruption is challenging and techniques of safe internal fixation are demanding. Constant dedication to improvement is must and should be the goal of pelvic surgeons.

BIBILOGRAPHY

BIBLIOGRAPHY

1. Tile M. pelvic ring fractures: should they be fixed? J Bone Join Surg. Vol. 70-B, 1-12; 1988.
2. Tile M. Fractures of Pelvis and Acetabulum. 3rd Ed. 1-10; 2005.
3. Webb LX, Caldwell K. Disruption of the pelvic ring caused by vertical shear. South Med J 1981; 10:1217.
4. McGowan S, Kellam KF, Tile M. Unstable pelvic ring disruptions – results of open reduction and internal fixation, Orthop Trans. 1987; 11:478.
5. Cole JD et al. Outcome after fixation of unstable posterior ring injuries. CORR No. 329, 1996; 160-179.
6. Sunil TM, Naresh Shetty. Indicators of morbidity pelvic fractures. Indian Journal of Orthopaedics. Vol 34, No.3, July 2000; 168-172.
7. Tornetta P, Dickson K, Matta JM. Outcome of rotationally unsyable pelvic ring injuries treated operatively. CORR. No. 329, PP. 147-151, 1996.
8. Goldstein A et al., Early open reduction and internal fixation of the disrupted pelvic ring . J. Trauma 1986; 26:325.
9. Miranda MA, Riemer BL, Butter field SL, Burke CJ. Pelvic ring injuries. Along from functional outcome study. CORR. No. 329. PP 152-159, 1996.

10. Webb LX, Grishina AG, Wilson Jr. J. Trauma 28(6); 813-817; June 1988.
11. Scheid DK, Kellam JF, Tile M. Open reduction and internal fixation of pelvic fractures. J. Orthop Trauma 5: 226: 199.
12. Porenetta P, Matta JM. Outcome of operatively treated unstable posterior pelvic ring disruptions. CORR No. 329, PP 186-193; 1996.
13. White RH, Goulet JA, Bray TJ, et al. Deep vein thrombosis after fracture of the pelvis: assessment with serial duplex- ultrasound screening. J Bone Joint surg. 1990; 72-A; 495-500.
14. Geerts WH, Code KI, Jay RM etal. A retrospective study of venous thromboembolism after major trauma. N Engl J Med 1994; 331: 1601-1606.
15. Holdsworth FW. Dislocation and fracture dislocation of the pelvis. J . Bone Joint Surg 1948; 30B: 461.
16. Peltier LF. Complications associated with fractures of pelvis. J Bone Joint Surg. 1965; 47A:1060.
17. Raf L. Double vertical fractures of the pelvis. Acta Chir Scand 1966; 131:298.
18. Huittinen VM, Slatis P. Fractures or the pelvis: A report 163 patients. Acta Chir Scand 1972; 138:799.

19. Slatis P, Karaharju ED. External fixation of unstable pelvic fractures. Experience in 22 patients treated with a trapezoid compression frame. Clin Orthop 1980; 151:73

20. Monahan PRW, Taylor RG. Dislocation and fracture dislocation of the pelvis. Injury 1975; 6:325

21. Melton L, Sampson J, Morrey B et al. Epidemiologic features of pelvic fractures. Clin Orthop 1981; 155:43

22. Edwards CC et al. Results of treating 50 unstable pelvic injuries using primary external fixation. Proceedings of the 53rd annual meeting of the American Academy of orthopaedic surgeons. Park Ridge, IL, 1986, P 434

23. Kellam JF, Murtry RY, Paley D et al. The unstable pelvic fracture: Operative treatment. Othop clin N Am 1987; 18:25

24. Browner BD, Cole JD, Graham JM, Bondurant FJ, Nunchuck- Burns SK, Colter HB. Delayed posterior internal fixation of unstable pelvic fractures. J. Trauma 1987 Sep; 27 (9): 998-1006

25. Rohen JW, Yokochi C. Color Atlas of Anatomy, 3rd ed. Igaku-Shoin, Philadelphia: Lippincott Williams & Wilkins, 1993

26. Wade R Smith, Bruce H Ziran, Steven J Morgan. Fractures of the pelvis and acetabulam

27. Ziran BH, Wasan AD, Marks DM, Olson SA, Chapman MW. Fluoroscopic imaging guides of the posterior pelvis pertaining to iliosacral screw placement. J Trauma 2007; 62(2):347–356
28. Metz CM, Hak DJ, Goulet JA, Williams D. Pelvic fracture pattern and their corresponding angiographic sources of hemorrhage. Orthop Clin Nam 35 (2004) 431-437.
29. Tile M. Acute pelvic fractures: I. Causation and classification. J Am Acad Orthop Surg 1996; 4:143–151
30. Orthopedic Trauma Association Committee for Coding and Classification. Fracture and Dislocation Compendium. J Orthop Trauma 1996; 10(suppl 1):1–154
31. Burgess AR, Eastridge BJ, Young JW, et al. Pelvic ring disruptions: effective classification system and treatment protocols. J Trauma 1990; 30:848–856
32. Olson SA, Burgess A. Classification and initial management of patients with unstable pelvic ring injuries. Instr Course Lect 2005; 54:383–393.
33. Bassam D, Cephas GA, Ferguson KA, et al. A protocol for the initial management of unstable pelvic fractures. Am Surg 1998; 64:862–867.
34. Routt ML Jr, Nork SE, Mills WJ. High-energy pelvic ring disruptions. Orthop Clin North Am 2002; 33:59–72, viii
35. Moed BR, Karges DE. Techniques for reduction and fixation of

pelvic ring disruptions through the posterior approach. Clin Orthop 1996; 329:102–114.

36. Leighton RK, Waddell JP. Techniques for reduction and posterior fixation through the anterior approach. Clin Orthop 1996; 329: 115– 120.

37. Routt ML, Jr. et al. Early results of percutaneous iliosacral screws placed with the patient in the supine position. J Orthop Trauma 1995; 9(3):207–214.

38. Bucholz R, Heckman J. Rockwood and Greens: Fractures in Adults, 5th ed. Baltimore: Lippincott Williams & Wilkins, 2001.

39. Leighton R, Waddell J. Open reduction and internal fixation of vertical fractures of the pelvis using the sacroiliac joint plate. J Orthop Trauma 1991; 5:225

40. Ruedi T, von Hoechstetter A, Schlumpf R. Surgical Approaches for Internal Fixation. Berlin: Springer-Verlag, 1984.

ANNEXURE

ANNEXURE 1: INFORMATION SHEET

We are conducting a study on **"ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF SACROILIAC DISRUPTIONS MANAGED SURGICALLY WITH INTERNAL FIXATION"** among patients attending the Institute of Orthopaedics & Traumatology, Rajiv Gandhi Government General Hospital, Chennai and for that your specimen may be valuable to us.

The purpose of this study is to evaluate and analyse the clinical, radiological and functional outcome of patients with sacroiliac disruptions managed surgically with internal fixation.

We are selecting certain cases and if you are found eligible, we may be using your radiographs of the pelvis (inlet and outlet view) to evaluate the outcome of surgery which in any way do not affect your final report or management.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator Signature of Participant

Date :

Place :

ANNEXURE 2: PATIENT CONSENT FORM

Study Detail : **"ANALYSIS OF CLINICAL, RADIOLOGICAL AND FUNCTIONAL OUTCOME OF SACROILIAC JOINT DISRUPTIONS MANAGED SURGICALLY WITH INTERNAL FIXATION"**

Study Centre : Rajiv Gandhi Government General Hospital, Chennai.

Patient's Name :

Patient's Age :

Identification Number:

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. □

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. □

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. □

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms. □

e) I hereby consent to participate in this study. □

f) I hereby give permission to undergo detailed clinical examination, Radiographs & blood investigations as required. □

Signature/thumb impression

Signature of Investigator

Patient's Name and Address:

Study Investigator's Name:

Dr. KETHARAN.S.K

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI – 3

EC Reg No. ECR/270/Inst. /TN/2013
Telephone No : 044 25305301
Fax : 044 25363970

Certificate of approval

To
Dr.S.K.Ketharan,
Post- graduate (M.S.Ortho), Institute of orthopaedics and traumatology
Madras medical college, Chennai-3.

Dear Dr.S.K.Ketharan.,

The Institutional Ethics Committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled **"FUNCTIONAL OUTCOME ANALYSIS OF SURGICAL MANAGEMENT (SCREW/PLATE) OF SACROILIAC JOINT DISRUPTIONS – SHORT TERM PROSPECTIVE & RETROSPECTIVE STUDY".** No.12102013.

The following members of Ethics Committee were present in the meeting held on 08.10.2013 conducted at madras medical college, Chennai-3.

1. Dr. G. Sivakumar, MS FICS FATS	---- Chairperson
2. Prof. R. Nandini, MD Director, instt. Of Pharmacology, MMC, Ch-3.	---- Member secretary
3. Prof. Ramadevi, Director i/c, Instt. Of Biochemistry, Chennai	---- Member
4. Prof. P. karkuzhali, MD Prof. Instt. Of Pathology, MMC, Ch-3.	---- Member
5. Prof. Kalaiselvi, MD Prof. of Pharmacology, MMC, Ch-3.	---- Member
6. Thiru. S. Govindasamy, BABL	---- Lawyer
7. Tmt. Arnold saulina, MA MSW	---- Social scientist

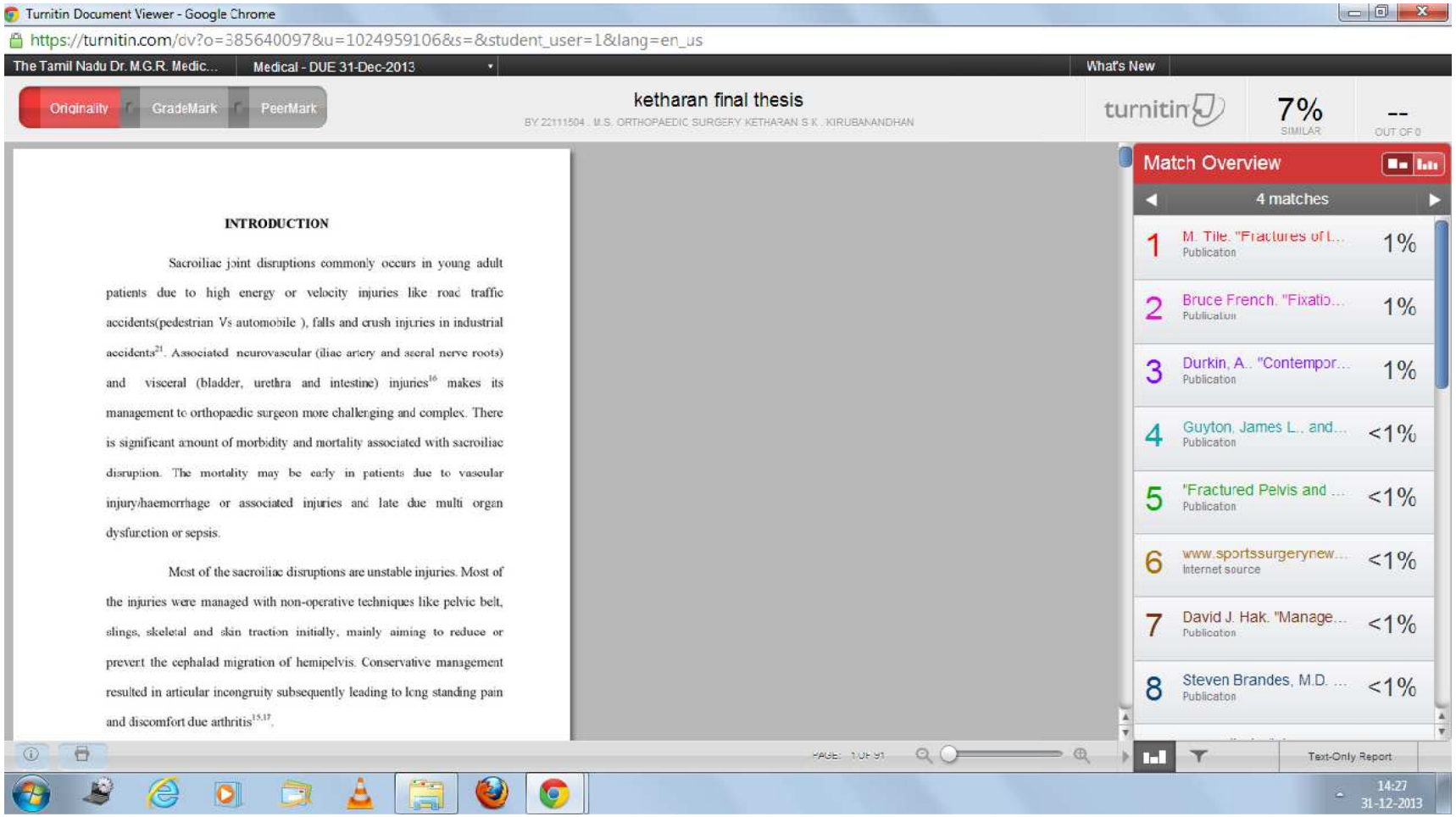
We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patient's information / informed consent and asks to be provided a copy of the final report.

R Nandini
Member Secretary. Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003


Turnitin Document Viewer - Google Chrome
https://turnitin.com/dv?o=385640097&u=1024959106&s=&student_user=1&lang=en_us
The Tamil Nadu Dr. M.G.R. Medic...
Medical - DUE 31-Dec-2013
What's New
Originality
GradeMark
PeerMark
ketharan final thesis
BY 22111504 . M.S. ORTHOPAEDIC SURGERY KETHARAN S K . KIRUBANANDHAN
turnitin
7%
SIMILAR
--
OUT OF 0
INTRODUCTION
Sacroiliac joint disruptions commonly occurs in young adult patients due to high energy or velocity injuries like road traffic accidents(pedestrian Vs automobile), falls and crush injuries in industrial accidents[21]. Associated neurovascular (iliac artery and sacral nerve roots) and visceral (bladder, urethra and intestine) injuries[16] makes its management to orthopaedic surgeon more challenging and complex. There is significant amount of morbidity and mortality associated with sacroiliac disruption. The mortality may be early in patients due to vascular injury/haemorrhage or associated injuries and late due multi organ dysfunction or sepsis.
Most of the sacroiliac disruptions are unstable injuries. Most of the injuries were managed with non-operative techniques like pelvic belt, slings, skeletal and skin traction initially, mainly aiming to reduce or prevent the cephalad migration of hemipelvis. Conservative management resulted in articular incongruity subsequently leading to long standing pain and discomfort due arthritis[15,17].
Match Overview
4 matches
1 M. Tile. "Fractures of t... Publication 1%
2 Bruce French. "Fixatio... Publication 1%
3 Durkin, A.. "Contempor... Publication 1%
4 Guyton, James L., and... Publication <1%
5 "Fractured Pelvis and ... Publication <1%
6 www.sportssurgerynew... Internet source <1%
7 David J. Hak. "Manage... Publication <1%
8 Steven Brandes, M.D. ... Publication <1%
Text-Only Report
14:27
31-12-2013

turnitin

Your digital receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

Paper ID	385640097
Paper title	ketharan final thesis
Assignment title	Medical
Author	22111504 . M.s. Orthopaedic Surgery KETHARAN S K . KIRUBANANDHAN
E-mail	dr.ketharan@gmail.com
Submission time	30-Dec-2013 07:41PM
Total words	10158

First 100 words of your submission

INTRODUCTION Sacroiliac joint disruptions commonly occurs in young adult patients due to high energy or velocity injuries like road traffic accidents(pedestrian Vs automobile), falls and crush injuries in industrial accidents21. Associated neurovascular (iliac artery and sacral nerve roots) and visceral (bladder, urethra and intestine) injuries16 makes its management to orthopaedic surgeon more challenging and complex. There is significant amount of morbidity and mortality associated with sacroiliac disruption. The mortality may be early in patients due to vascular injury/haemorrhage or associated injuries and late due multi organ dysfunction or sepsis. Most of the sacroiliac disruptions...

MASTER CHART

S. NO	Name & I.P.No.	Age/ Sex	Date of admission	Mode Of injury	X-ray features	Classificati -on	Asso. injuries	Date of surgery	Time delay	Procedure	Surgical time	Complicatio -ns	Follow- up	Outcome Total=40 (Cole et al)	Result
1	Jayashankar Ip-69108	40/M	03-11-11	RTA	SI Jt widening(Rt)	Type C1	Transverse # (Rt) acetabulum	05-11-11	2 days	Open reduction & iliosacral screw fixation	100 minutes	Nil	15 months	36	Good
2	Murugan Ip-20559	42/M	02/02/12	RTA	SI joint widening(Lt)	Type C1	Humerus shaft # (Rt)	05-02-12	3 days	ORIF & iliosacral screw post. approach	90 minutes	Nil	16 months	35	Good
3	Arumugam Ip-70608	31/M	20-04-12	RTA	Symphysis diastasis, Rt SI widening	Type B1	Nil	20-04-12 & 22-04-12	2 days	Pelvic Ex fix & Percutaneou SI Jt screw	45 minutes	Nil	11 months	33	Good
4	Sampath Ip-77344	58/M	21-05-12	Fall from heigh t	SI Jt widening & rami # Lt side	Type C1	Scapula & rib # Lt side	28-05-12	7 days	ORIF & SI Jt plating	110 minutes	Nil	Lost	NA	NA
5	Gurunathan Ip-115226	55/M	23-08-12	RTA	SI Jt widening & liliac wing and rami # Lt	Type C2	Rib # Lt sidel	01-09-12	9 days	ORIF & plating for SI Jt & rami	130 minutes	infection	14 months	31	Fair
6	Rajendran Ip-117756	46/M	27-08-12	RTA	Symphysis diastasis, Rt SI widening	Type B2	Femur # Rt	30-08-12	3 days	Percutaneou Iliosacral screw	50 minutes	Nil	13 months	36	Good

S. NO	Name & I.P.No.	Age/ Sex	Date of admission	Mode Of injury	X-ray features	Classificati -on	Asso. injuries	Date of surgery	Time delay	Procedure	Surgical time	Complicatio -ns	Follow- up	Outcome Total=40 (Cole et al)	Result
7	Elumalai Ip-109832	30/M	03-09-12	RTA	B/L SI Jt widenening & rami #	Type B3	Nil	08-09-12	5 days	Percutaneou Iliosacral screw lt side	50 minutes	Nil	12 months	33	Good
8	Babu Ip-111143	24/M	15-09-12	RTA	Straddle # & SI Jt disruptions Rt side	Type C1	Nil	19-09-12	4 days	ORIF with recon plate for SI Jt and rami	105 minutes	Nil	11 months	34	Good
9	Mohamed Ali Ip-1116034	34/M	22-10-12	RTA	SI Jt disruption Rt side & rami # Lt side	Type C2	# dislocation Rt hip	24-10-12	2 days	Percutaneou iliosacral screw & recon plate for rami	110 minutes	Nil	11 months	36	Good
10	Ramadoss Ip-1215840	46/m	23-12-12	RTA	SI Jt widening & sacral # type II Jt side	Type C1	Nil	30-12-12	7 days	Sacral foramina decompressi on & iliosacral srew fixation	120 minutes	Nil	11 months	32	Good
11	Ramadoss Ip-28633	57/M	03-03-13	RTA	SI Jt disruption Lt side	Type C1	Anterior wall & column # Lt side	05-03-13	2 days	Percutaneou Iliosacral screw	40 minutes	Nil	8 months	36	Good
12	Kowsalya Ip-30936	16/F	21-03-13	RTA	SI Jt widening Rt side	Type B2	Nil	23-03-13	2 days	Percutaneou Iliosacral screw	45 minutes	Nil	8 months	37	Good

S. NO	Name & I.P.No.	Age/ Sex	Date of admission	Mode Of injury	X-ray features	Classificati -on	Asso. injuries	Date of surgery	Time delay	Procedure	Surgical time	Complicatio -ns	Follow- up	Outcome Total=40 (Cole et al)	Result
13	Muthulaksm Ip-32412	38/F	04-04-13	Fall from heigh	SI Jt widening & # Rt iliac wing	Type B2	Anterio column acetabulum BB # leg & forearm Rt	08-04-13	4 days	ORIF with recon plate for SI Jt & iliac wing	120 minutes	Nil	7 months	30	Fair
14	Jayavel Ip-49161	42/M	30-04-13	RTA	SI Jt disruption Lt side	Type C1	BB # right leg & monteggia # Lt side	07-05-13	7 days	Percutaneou ilisacral screw	40 minutes	Nil	7 months	35	Good
15	Anandan Ip-49842	35/M	01-05-13	RTA	# dislocation Lt SI Jt & both rami fracture	Type B2	Nil	04-05-13	3 days	ORIF with recon plate	110 min	L5 paresis	6 months	33	Good
16	Prakash IP-50290	40/M	03-05-13	RTA	SI Jt disruption, iliac wing # Lt side	Type C2	anterior wall acetabulum # Lt side	08-05-13	5 days	ORIF with recon plate for SI Jt & iliac wing	100 minutes	Nil	6 months	34	Good
17	Sivalingam Ip-61432	21/m	21-05-13	RTA	SI Jt disruption Rt with B/L rami #	Type C1	Nil	23-05-13	2 days	Percutaneou ilisacral screw	45 minutes	Nil	5 months	35	Good
18	Babu Ip-62334	43/M	03-06-13	RTA	SI Jt disruption Lt	Type C1	Urethral injury	10-06-13	7 days	Pelvic ex fix percutaneou iliosacral screw	50 minutes	Nil	5 months	36	Good

S. NO	Name & I.P.No.	Age/ Sex	Date of admission	Mode Of injury	X-ray features	Classificati -on	Asso. injuries	Date of surgery	Time delay	Procedure	Surgical time	Complicatio -ns	Follow- up	Outcome Total=40 (Cole et al)	Result
19	Rangan Ip-64893	49/M	11-06-13	RTA	Straddle fracture & SI Jt disruption Rt	Type C1	Nil	15-06-13	4 days	Percutaneou iliosacral screw	50 minutes	Nil	5 months	34	Good
20	Sundaram Ip-70123	40/M	27-06-13	TTA	SI Jt disruption Rt	Type C1	Nil	30-06-13	3 days	Percutaneou iiosacral screw	45 minutes	Nil	4 months	33	Good
21	Palaniamma Ip-74432	38/F	21-07-13	RTA	SI Jt disruption, crescent & rami # Lt	Type C2	Bladder injury	29-07-13	8 days	Percutaneou iliosacral screw	40 minutes	Nil	4 months	36	Good

ABBREVIATION

RTA - Road traffic accident

TTA -Train traffic accident

ORIF -Open reduction and internal fixation

SI - Sacroiliac

Jt - Joint

- Fracture

Rt - Right

Lt - Left

Ex Fix- External fixation

B/L - Bilateral

BB - Both Bone